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Information technology — Security techniques — Systems Security Engineering — Capability Maturity Model® (SSE-CMM®)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 21827 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 27, *IT Security techniques*. In addition, alignment is being maintained with the publicly available System Security Engineering - Capability Maturity Model® [1)] (SSE-CMM®) Version 3, published by the International Systems Security Engineering Association (ISSEA) as a Publicly Available Specification.

This second edition cancels and replaces the first edition (ISO/IEC 21827:2002), which has been technically revised.

SSE-CMM includes excerpts from “A Systems Engineering Capability Maturity Model (SE-CMM), Version 1.1”, CMU/SEI—95-MM-003, Copyright 1995 by Carnegie Mellon University. SE-CMM is a collaborative effort of Hughes Space and Communications, Hughes Telecommunications and Space, Lockheed Martin, Software Engineering Institute, Software Productivity Consortium, and Texas Instruments Incorporated. Neither Carnegie Mellon University nor the Software Engineering Institute directly or indirectly endorse SSE-CMM or ISO/IEC 21827.

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0 Introduction

0.1 General

A wide variety of organizations practice security engineering in the development of computer programs, whether as operating systems software, security managing and enforcing functions, software, middleware or applications programs. Appropriate methods and practices are therefore required by product developers, service providers, system integrators, system administrators, and even security specialists. Some of these organizations deal with high-level issues (e.g., ones dealing with operational use or system architecture), others focus on low-level issues (e.g., mechanism selection or design), and some do both. Organizations may specialize in a particular type of technology or a specialized context (e.g., at sea).

The SSE-CMM® is designed for all these organizations. Use of the SSE-CMM should not imply that one focus is better than another or that any of these uses are required. An organization's business focus need not be biased by use of the SSE-CMM®.

Based on the focus of the organization, some, but not all, of the security engineering practices defined will apply. In addition, the organization may need to look at relationships between different practices within the model to determine their applicability. The examples below illustrate ways in which the SSE-CMM® may be applied to software, systems, facilities development and operation by a variety of different organizations.

This International Standard has a relationship to ISO/IEC 15504, particularly ISO/IEC 15504-2, as both are concerned with process improvement and capability maturity assessment. However, ISO/IEC 15504 is specifically focused on software processes, whereas the SSE-CMM is focused on security.

This International Standard has a closer relationship with the new versions of ISO/IEC 15504, particularly ISO/IEC 15504-2, and is compatible with its approaches and requirements.

Security service providers

To measure the process capability of an organization that performs risk assessments, several groups of practices come into play. During system development or integration, one would need to assess the organization with regard to its ability to determine and analyze security vulnerabilities and assess the operational impacts. In the operational case, one would need to assess the organization with regard to its ability to monitor the security posture of the system, identify and analyze security vulnerabilities and threats, and assess the operational impacts.

Countermeasure developers

In the case of a group that focuses on the development of countermeasures, the process capability of an organization would be characterized by a combination of SSE-CMM® practices. The model contains practices to address determining and analyzing security vulnerabilities, assessing operational impacts, and providing input and guidance to other groups involved (such as a software group). The group that provides the service of developing countermeasures needs to understand the relationships between these practices.

Product developers

The SSE-CMM® includes practices that focus on gaining an understanding of the customer's security needs. Interaction with the customer is required to ascertain them. In the case of a product, the customer is generic as the product is developed a priori independent of a specific customer. When this is the case, the product marketing group or another group can be used as the hypothetical customer, if one is required.

Practitioners in security engineering recognize that the product contexts and the methods used to accomplish product development are as varied as the products themselves. However, there are some issues related to product and project context that are known to have an impact on the way products are conceived, produced, delivered and maintained. The following issues in particular have significance for the SSE-CMM®:

- type of customer base (products, systems, or services);
- assurance requirements (high vs. low); and
- support for both development and operational organizations.

The differences between two diverse customer bases, differing degrees of assurance requirements, and the impacts of each of these differences in the SSE-CMM® are discussed below. These are provided as an example of how an organization or industry segment might determine appropriate use of the SSE-CMM® in their environment.

Specific industry segments

Every industry reflects its own particular culture, terminology and communication style. By minimizing the role dependencies and organization structure implications, it is anticipated that the SSE-CMM® concepts can be easily translated by all industry segments into their own language and culture.

0.2 How should the SSE-CMM® be used?

The SSE-CMM® and the method for applying the model (i.e., appraisal method) are intended to be used as a:

- tool for engineering organizations to evaluate their security engineering practices and define improvements;
- method by which security engineering evaluation organizations such as certifiers and evaluators can establish confidence in the organizational capability as one input to system or product security assurance; and
- standard mechanism for customers to evaluate a provider's security engineering capability.

The scope of the assessment should be defined by the assessment organization and discussed with the assessor, if applicable.

The appraisal techniques can be used in applying the model for self improvement and in selecting suppliers, if the users of the model and appraisal methods thoroughly understand the proper application of the model and its inherent limitations. Additional information on using process assessment can be found in ISO/IEC 15504-4, *Information technology — Process assessment — Part 4: Guidance on use for process improvement and process capability determination*.

0.3 Benefits of using the SSE-CMM®

The trend for security is a shift from protecting classified government data to a broader spectrum of concerns including financial transactions, contractual agreements, personal information and the Internet. A corresponding proliferation of products, systems and services that maintain and protect information has emerged. These security products and systems typically come to market in one of two ways: through lengthy and expensive evaluation or without evaluation. In the former case, trusted products often reach the market long after their features are needed and secure systems are being deployed that no longer address current threats. In the latter case, acquirers and users must rely solely on the security claims of the product or system developer or operator. Further, security engineering services traditionally were often marketed on this *caveat emptor* basis.

This situation calls for organizations to practice security engineering in a more mature manner. Specifically, the following qualities are needed in the production and operation of secure systems and trusted products:

- continuity - knowledge acquired in previous efforts is used in future efforts;
- repeatability - a way to ensure that projects can repeat a successful effort;
- efficiency - a way to help both developers and evaluators work more efficiently; and
- assurance - confidence that security needs are being addressed.

To provide for these requirements, a mechanism is needed to guide organizations in understanding and improving their security engineering practices. To address these needs, the SSE-CMM® is being developed to advance the state of the practice of security engineering with the goal of improving the quality and availability of and reducing the cost of delivering secure systems, trusted products and security engineering services. In particular, the following benefits are envisioned.

To engineering organizations:

Engineering organizations include System Integrators, Application Developers, Product Vendors and Service Providers. Benefits of the SSE-CMM® to these organizations include:

- savings with less rework from repeatable, predictable processes and practices;
- credit for true capability to perform, particularly in source selections; and
- focus on measured organizational competency (maturity) and improvements.

To acquiring organizations:

Acquirers include organizations acquiring systems, products and services from external/internal sources and end users. Benefits of the SSE-CMM® to these organizations include:

- reusable standard Request for Proposal language and evaluation means;
- reduced risks (performance, cost, schedule) of choosing an unqualified bidder;
- fewer protests due to uniform assessments based on industry standard; and
- predictable, repeatable level of confidence in product or service.

To evaluation organizations:

Evaluation organizations include system certifiers, system accreditors, product evaluators, and product assessors. Benefits of the SSE-CMM® to these organizations include:

- reusable process appraisal results, independent of system or product changes;
- confidence in security engineering and its integration with other disciplines; and
- capability-based confidence in evidence, reducing security evaluation workload.

Information technology — Security techniques — Systems Security Engineering — Capability Maturity Model® (SSE-CMM®)

1 Scope

This International Standard specifies the Systems Security Engineering – Capability Maturity Model® (SSE-CMM®). The SSE-CMM® is a process reference model focused upon the requirements for implementing security in a system or series of related systems that are the information technology security (ITS) domain. Within the ITS domain, the SSE-CMM® is focused on the processes used to achieve ITS, most specifically on the maturity of those processes. There is no intent within the SSE-CMM® to dictate a specific process to be used by an organization, let alone a specific methodology. Rather the intent is that the organization making use of the SSE-CMM® should use its existing processes, be those processes based upon any other ITS guidance document. The scope encompasses:

- the system security engineering activities for a secure product or a trusted system addressing the complete life cycle of concept definition, requirements analysis, design, development, integration, installation, operation, maintenance and de-commissioning;
- requirements for product developers, secure systems developers and integrators, organizations that provide computer security services and computer security engineering; and
- all types and sizes of security engineering organization, from commercial to government and the academe.

While the SSE-CMM® is a distinct model to improve and assess security engineering capability, this does not imply that security engineering should be practised in isolation from other engineering disciplines. On the contrary, the SSE-CMM® promotes integration, taking the view that security is pervasive across all engineering disciplines (e.g., systems, software and hardware) and defining components of the model to address such concerns. The Common Feature “Coordinate Practices” recognizes the need to integrate security with all disciplines and groups involved on a project or within an organization. Similarly, the Process Area “Coordinate Security” defines the objectives and mechanisms to be used in coordinating the security engineering activities.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 15504-2, *Information technology — Process assessment — Part 2: Performing an assessment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
accountability
property that ensures that the actions of an entity can be traced uniquely to the entity

[ISO/IEC 7498-2:1989]

3.2
accreditation
formal declaration by a designated approving authority that a system is approved to operate in a particular security mode using a prescribed set of safeguards

NOTE This definition is generally accepted within the security community; within ISO the more generally used definition is: Procedure by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks [ISO/IEC Guide 2].

3.3
assessment
verification of a product, system or service against a standard using the corresponding assessment method to establish compliance and determine the assurance

NOTE Adapted from ISO/IEC TR 15443-1:2005.

3.4
asset
anything that has value to the organization

[ISO/IEC TR 13335-1:1996]

3.5
assurance
grounds for confidence that a deliverable meets its security objectives

NOTE 1 Adapted from ISO/IEC 15408-1:2005.

NOTE 2 This definition is generally accepted within the security community; within ISO the more generally used definition is: Activity resulting in a statement giving confidence that a product, process or service fulfills specified requirements [ISO/IEC Guide 2].

3.6
assurance Argument
set of structured assurance claims, supported by evidence and reasoning, that demonstrate clearly how assurance needs have been satisfied

3.7
assurance Claim
assertion or supporting assertion that a system meets a security need

NOTE Claims address both direct threats (e.g. system data are protected from attacks by outsiders) and indirect threats (e.g. system code has minimal flaws).

3.8
assurance Evidence
data on which a judgment or conclusion about an assurance claim may be based

NOTE The evidence may consist of observation, test results, analysis results and appraisals.

3.9
authenticity
property that ensures that the identity of a subject or resource is the one claimed

NOTE 1 Authenticity applies to entities such as users, processes, systems and information.

NOTE 2 Adapted from ISO/IEC TR 13335-1:1996.

3.10
availability
property of being accessible and useable upon demand by an authorized entity

[ISO/IEC 7498-2:1989]

3.11
baseline
specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures

[IEEE-Std. 610]

3.12
certification
process, producing written results, of performing a comprehensive evaluation of security features and other safeguards of a system to establish the extent to which the design and implementation meet a set of specified security requirements

NOTE This definition is generally accepted within the security community; within ISO the more generally used definition is: Procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements [ISO/IEC Guide 2].

3.13
confidentiality
property that information is not made available or disclosed to unauthorized individuals, entities or processes

[ISO/IEC 7498-2:1989]

3.14
consistency
degree of uniformity, standardization and freedom from contradiction among the documents or parts of a system or component

[IEEE-Std. 610]

3.15
correctness
for specified security requirements, the representation of a product or system that shows that the implementation of the requirement is correct

3.16
customer
recipient of a product provided by the supplier

NOTE 1 In a contractual situation, the customer is called the purchaser.

NOTE 2 The customer may be, for example, the ultimate consumer, user, beneficiary or purchaser.

NOTE 3 The customer can be either external or internal to the organization. See ISO 9000 and ISO/IEC 15504.

3.17
effectiveness
property of a system or product representing how well it provides security in the context of its proposed or actual operational use

3.18
engineering group
collection of individuals (both managers and technical staff) which is responsible for project or organizational activities related to a particular engineering discipline

NOTE Engineering disciplines include the following: hardware, software, software configuration management, software quality assurance, systems, system test, system security.

3.19
evidence
directly measurable characteristics of a process and/or product that represent objective, demonstrable proof that a specific activity satisfies a specified requirement

3.20
integrity
property of safeguarding the accuracy and completeness of information and processing methods

3.21
maintenance
process of modifying a system or component after delivery to correct flaws, improve performance or other attributes, or adapt to a changed environment

[IEEE-Std. 610]

3.22
methodology
collection of standards, procedures and supporting methods that define the complete approach to the development of a product or system

3.23
penetration profile
definition of the activities required to effect a penetration

3.24
procedure
written description of a course of action to be taken to perform a given task

[IEEE-Std. 610]

3.25
process
set of interrelated activities which transform inputs into outputs

NOTE Adapted from ISO/IEC 15288:2002.

3.26
reliability
property of consistent behaviour and results

[ISO/IEC TR 13335-1:1996]

3.27
residual risk
risk that remains after safeguards have been implemented

[ISO/IEC TR 13335-1:1996]

NOTE This definition differs from that used in ISO/IEC Guide 73.

3.28
risk
potential that a given threat will exploit vulnerabilities of an asset or group of assets to cause loss or damage to the assets

[ISO/IEC TR 13335-1:1996]

NOTE This definition differs from that used in ISO/IEC Guide 73.

3.29
risk analysis
process of identifying security risks, determining their magnitude and identifying areas needing safeguards

[ISO/IEC TR 13335-1:1996]

NOTE This definition differs from that used in ISO/IEC Guide 73.

3.30
risk management
process of assessing and quantifying risk and establishing an acceptable level of risk for the organization

[ISO/IEC TR 13335-1:1996]

NOTE This definition differs from that used in ISO/IEC Guide 73.

3.31
security policy
rules, directives and practices that govern how assets, including sensitive information, are managed, protected and distributed within an organization and its systems, particularly those which impact the systems and associated elements

3.32
security related requirements
requirements which have a direct effect on the secure operation of a system or enforce conformance to a specified security policy

3.33
system
discrete, distinguishable entity with a physical existence and a defined purpose, completely composed of integrated, interacting components, each of which does not individually comply with the required overall purpose

NOTE 1 Adapted from ISO/IEC 15288.

NOTE 2 In practice, a system is “in the eye of the beholder” and the interpretation of its meaning is frequently clarified by the use of an associative noun (e.g. product system, aircraft system). Alternatively the word system may be substituted simply by a context dependent synonym (e.g. product, aircraft), though this may then obscure a system principles perspective.

NOTE 3 The system may need other systems during its life cycle to meet its requirements. For example, an operational system may need a system for conceptualization, development, production, operation, support or disposal.

3.34
threat
capabilities, intentions and attack methods of adversaries, or any circumstance or event, whether originating externally or internally, that has the potential to cause harm to information or to a program or system, or to cause these to harm others

3.35
threat agent
originator and/or initiator of deliberate or accidental man-made threats

3.36
validation
confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled

NOTE Adapted from ISO/IEC 15288.

3.37
verification
confirmation by examination and provision of objective evidence that specified requirements have been fulfilled

NOTE Adapted from ISO/IEC 15288.

3.38
vulnerability
includes a weakness of an asset or group of assets which can be exploited by a threat

[ISO/IEC TR 13335-1:1996]

3.39
work product
artifact associated with the execution of a process

[ISO/IEC 15504-1]

NOTE A work product might be used, produced or changed by a process.

4 Background

The Systems Security Engineering Capability Maturity Model® (SSE-CMM®) describes the essential characteristics of an organization's security engineering process that must exist to ensure good security engineering. The SSE-CMM® does not prescribe a particular process or sequence, but captures practices generally observed in industry. The model is a standard metric for security engineering practices covering:

- the entire life cycle, including development, operation, maintenance, and decommissioning activities;
- the whole organization, including management, organizational, and engineering activities;
- concurrent interactions with other disciplines, such as system, software, hardware, human factors, and test engineering; system management, operation, and maintenance; and
- interactions with other organizations, including acquisition, system management, certification, accreditation, and evaluation.

The SSE-CMM® Model Description provides an overall description of the principles and architecture upon which the SSE-CMM® is based, an executive overview of the model, suggestions for appropriate use of the model, the practices included in the model, and a description of the attributes of the model. It also includes the requirements used to develop the model. The SSE-CMM® Appraisal Method describes the process and tools for evaluating an organization's security engineering capability against the SSE-CMM®.

4.1 Reason for Development

Both customers and suppliers are interested in improving the development of security products, systems, and services. The field of security engineering has several generally accepted principles, but it currently lacks a comprehensive framework for evaluating security engineering practices. The SSE-CMM®, by identifying such a framework, provides a way to measure and improve performance in the application of security engineering principles.

It must be stressed that security engineering is a unique discipline, requiring unique knowledge, skills, and processes which warrants the development of a distinct CMM® for security engineering. This does not conflict with the premise that security engineering is done in context with systems engineering. In fact, having well-defined and accepted systems engineering activities will allow security engineering to be practised effectively in all contexts.

Modern statistical process control suggests that higher quality products can be produced more cost-effectively by emphasizing the quality of the processes that produce them, and the maturity of the organizational practices inherent in those processes. More efficient processes are warranted, given the increasing cost and time required for the development of secure systems and trusted products. The operation and maintenance of secure systems relies on the processes that link the people and technologies. These interdependencies can be managed more cost effectively by emphasizing the quality of the processes being used, and the maturity of the organizational practices inherent in the processes.

The objective of the SSE-CMM® Project is to advance security engineering as a defined, mature, and measurable discipline. The SSE-CMM® model and appraisal methods are being developed to enable:

- focused investments in security engineering tools, training, process definition, management practices, and improvements by engineering groups;
- capability-based assurance, (i.e. trustworthiness based on confidence in the maturity of an engineering group's security practices and processes); and
- selection of appropriately qualified providers of security engineering through differentiating bidders by capability levels and associated programmatic risks.

4.2 The Importance of Security Engineering

With the increasing reliance of society on information, the protection of that information is becoming increasingly important. Many products, systems, and services are needed to maintain and protect information. The focus of security engineering has expanded from one primarily concerned with safeguarding classified government data to broader applications including financial transactions, contractual agreements, personal information, and the Internet. These trends have elevated the importance of security engineering.

4.3 Consensus

The SSE-CMM® Model was developed by over 50 organizations, many of them multinational corporations. The Project had representatives from several Nations, notably Australia, Canada, Europe and the US. In addition, the SSE-CMM® project continually sought participation through various venues, including presentations and booths at conferences and through the public website www.ssecmm.org.

The participants were organized into a Steering Group, and a number of Working Groups. The majority of the development was performed by the Working Groups, while the Steering Group was responsible for overall project progress and approval of Project deliverables.

The SSE-CMM® model was developed by a consensus process. All member organizations could send representatives to the working group meetings, and the majority did. Contributions were sent electronically to all members of the working group in the intervening period between meetings. Meetings were held on a monthly basis where input suggestions were discussed, revised and agreed. The results of any votes that were necessary were recorded in the working group meeting minutes issued for each meeting. These records have been maintained.

Each version of the SSE-CMM® Model was first approved by the working group tasked with development. It was then reviewed and approved by the Steering Group. After the Steering Group had approved the version it was then sent to a group of “Key Reviewers” drawn from the ITS community at large for their review and comment. Each version was then released for public review and feedback. Based on the feedback from the Key Reviewers and the community at large, the Steering Group made a determination of the final release of that version of the SSE-CMM® Model.

The SSE-CMM® Model has been approved first at the working group level, second at the Steering Group level, third at the Key Reviewer level, and finally at the community level. Thus, in essence, four levels of approval have been obtained.

Additional approval and consensus has been achieved during the Pilot Appraisals through the impact of application of the Model to different application domains. The Alternative Assurance Working Group (AAWG) of the Common Criteria Project has reviewed the SSE-CMM® Model for applicability as an alternative to the generation of assurance by evaluation and provided IT systems security community consensus feedback to the project.

Each major release of the Model was reviewed by a set of independent reviewers who had not been involved in its development. Their comments were consolidated, reviewed and incorporated in the Model. Finally, each version of the document was subjected to public review, the Critical Design Review and the two public workshops, and the comments received, addressed.

5 Structure of the Document

Clause 4 discusses some of the background of the document and the reasons for its development. Clause 6 addresses the architecture of the SSE-CMM Model and the role of systems security engineering. Clause 7 describes the systems security engineering process areas and base practices in detail. Annex A describes the capability maturity levels and generic practices, while Annex B describes the project and organization process areas and base practices. Annex C discusses the concepts of capability maturity models.

6 Model Architecture

The SSE-CMM® is a compilation of the security engineering best practices. To understand this model, some background in security engineering is required. This section provides a high level description of security engineering, and then describes how the architecture of the model reflects this basic understanding.

6.1 Security Engineering

6.1.1 What Is Security Engineering?

The drive toward pervasive interconnectivity and interoperability of networks, computers, applications, and even enterprises is creating a more pivotal role for security in all systems and products. The focus of security has moved from safeguarding classified government data, to a wider application, including financial transactions, contractual agreements, personal information, and the Internet. As a result, it is necessary that potential security needs are considered and determined for any application. Examples of needs to consider include confidentiality, integrity, availability, accountability, privacy, and assurance.

The shift in focus of security issues elevates the importance of security engineering. Security engineering is becoming an increasingly critical discipline and should be a key component in multi-disciplinary, concurrent, engineering teams. This applies to the development, integration, operation, administration, maintenance, and evolution of systems and applications as well as to the development, delivery, and evolution of products. Security concerns must be addressed in the definition, management, and re-engineering of enterprises and business processes. Security engineering can then be delivered in a system, in a product, or as a service.

6.1.2 Description of Security Engineering

Security engineering is an evolving discipline. As such, a precise definition with community consensus does not exist today. However, some generalizations are possible. Some goals of security engineering are to:

- gain understanding of the security risks associated with an enterprise;
- establish a balanced set of security needs in accordance with identified risks;
- transform security needs into security guidance to be integrated into the activities of other disciplines employed on a project and into descriptions of a system configuration or operation;
- establish confidence or assurance in the correctness and effectiveness of security mechanisms;
- determine that operational impacts due to residual security vulnerabilities in a system or its operation are tolerable (i.e. determine acceptable risks); and
- integrate the efforts of all engineering disciplines and specialties into a combined understanding of the trustworthiness of a system.

6.1.3 Security Engineering Organizations

Security engineering activities are practised by various types of organizations, such as:

- developers;
- product vendors;
- integrators;
- acquirers (acquisition organization or end user);
- security evaluation organizations (system certifier, product evaluator, or operation accreditor);
- system administrator;
- trusted third parties (certification authority); and
- consulting/service organizations.

6.1.4 Security Engineering Life Cycle

Security engineering activities are practised during all life cycle phases, including:

- concept stage;
- development stage;
- production stage;
- utilization stage;
- support stage; and
- retirement stage.

6.1.5 Security Engineering and Other Disciplines

Security engineering activities interface with many other disciplines, including:

- enterprise engineering;
- systems engineering;
- software engineering;
- human factors engineering;
- communications engineering;
- hardware engineering;
- test engineering; and
- system administration.

NOTE 1 With respect to systems engineering, further information can be found in ISO/IEC 15288 which views security from a systems perspective.

NOTE 2 With respect to software engineering, further information can be found in ISO/IEC 12207:1995 which views security from a software perspective.

Security engineering activities must be coordinated with many external entities because assurance and the acceptability of residual operational impacts are established in conjunction with the developer, integrator, acquirer, user, independent evaluator, and other groups. It is these interfaces and the requisite interaction across a broad set of organizations that make security engineering particularly complex and different from other engineering disciplines.

6.1.6 Security Engineering Specialties

While Security Engineering and Information Technology Security are very often the driving disciplines in the current security and business environment, other more traditional security disciplines, such as Physical Security and Personnel Security should not be overlooked. Security Engineering will need to draw upon these and many other specialist sub-disciplines if they are to achieve the most efficient and effective results in the performance of their work. The list below gives a few examples of specialty security sub-disciplines likely to be required, along with a short description of each, including:

- operations Security targets the security of the operating environment, and the maintenance of a secure operating posture;
- information Security pertains to information and the maintenance of security of the information during its manipulation and processing;
- network Security involves the protection of network hardware, software, and protocols, including information communicated over networks;
- physical Security focuses on the protection buildings and physical locations;
- personnel Security is related to people, their trustworthiness and their awareness of security concerns;
- administrative Security is related to the administrative aspects of security and security in administrative systems;

- communications Security (content and traffic security) is related to the communication of information between security domains, specifically the protection of information while it is being moved through the transport medium;

- emanation Security deals with undesired signals generated by all machines that can transmit information outside the security domain; and

- computer Security deals specifically with security computing devices of all types.

6.2 Security Engineering Process Overview

The SSE-CMM® divides security engineering into three basic areas: risk, engineering, and assurance, see Figure 1. While these areas are by no means independent from one another, it is possible to consider them separately. At the simplest level, the risk process identifies and prioritizes dangers inherent to the developed product or system. The security engineering process works with the other engineering disciplines to determine and implement solutions to the problems presented by the dangers. Finally, the assurance process establishes confidence in the security solutions and conveys this confidence to the customers.

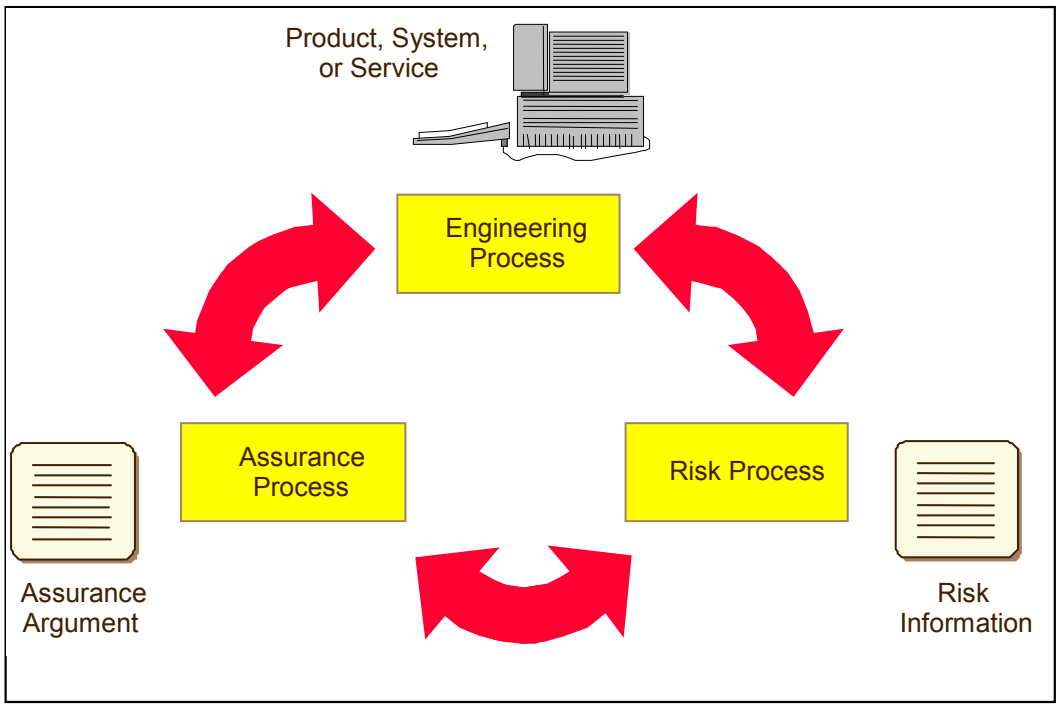

Figure 1 — The security engineering process has three main areas

Together, these three areas work together with the goal of ensuring that the security engineering process results achieve the goals described above.

6.2.1 Risk

A major goal of security engineering is the reduction of risk. Risk assessment is the process of identifying problems that have not yet occurred. Risks are assessed by examining the likelihood of the threat and vulnerability and by considering the potential impact of an unwanted incident, see Figure 2. Associated with that likelihood is a factor of uncertainty, which will vary dependent upon a particular situation. This means that the likelihood can only be predicted within certain limits. In addition, the impact assessed for a particular risk also has associated uncertainty, as the unwanted incident may not turn out as expected. Because the factors may have a large amount of uncertainty as to the accuracy of the predictions associated with them, planning

and the justification of security can be very difficult. One way to partially deal with this problem in a cost-effective manner is to implement techniques to detect the occurrence of an unwanted incident.

An unwanted incident is made up of three components: threat, vulnerability, and impact. Vulnerabilities are properties of the asset that may be exploited by a threat and include weaknesses. If either the threat or the vulnerability is not present there can be no unwanted incident and thus no risk. Risk management is the all the activities that need to be coordinated to direct and control an organisations risk management activities. It includes establishing an acceptable level of risk for an organisation and identifying, analysing, evaluating and treating risks accordingly. Managing risk is an important part of the management of security.

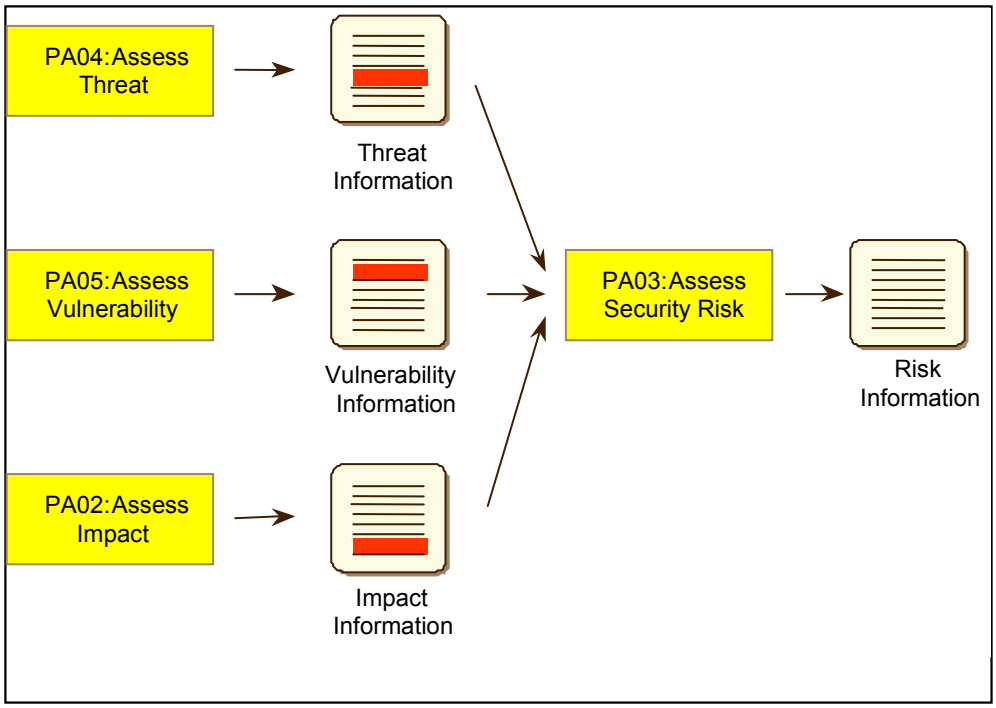

Figure 2 — The security risk process involves threats, vulnerabilities, and impact.

Risks are treated by the implementation of safeguards, which may address the threat, the vulnerability, the impact, or the risk itself. However, it is not feasible to treat all risks or completely mitigate any particular risk. This is in large part due to the cost of risk treatment, and to the associated uncertainties. Thus, some residual risk must always be accepted. In the presence of high uncertainty, risk acceptance becomes very problematic due to its inexact nature. One of the few areas under the risk taker's control is the uncertainty associated with the system. The SSE-CMM® process areas include activities that ensure that the provider organization is analyzing threats, vulnerabilities, impacts, and associated risk.

NOTE The ordering of the process areas is strictly alphabetical based on the title of the Process Area. This is done in order not to infer any sequence or precedence in the ordering of the Process Areas.

6.2.2 Engineering

Security engineering, like other engineering disciplines, is a process that proceeds through concept, design, implementation, test, deployment, operation, maintenance, and decommission. Throughout this process, security engineers must work closely with the other parts the system engineering team. The SSE-CMM® emphasizes that security engineers are part of a larger team and need to coordinate their activities with engineers from other disciplines. This helps to ensure that security is an integral part of the larger process, and not a separate and distinct activity.

Using the information from the risk process described above, and other information about system requirements, relevant laws, and policies, security engineers work with the customer to identify security needs, see Figure 3. Once needs are identified, security engineers identify and track specific requirements.

The process of creating solutions to security problems generally involves identifying possible alternatives and then evaluating the alternatives to determine which is the most promising. The difficulty in integrating this activity with the rest of the engineering process is that the solutions cannot be selected on security considerations alone. Rather, a wide variety of other considerations, including cost, performance, technical risk, and ease of use must be addressed. Typically, these decisions should be captured to minimize the need to revisit issues. The analyses produced also form a significant basis for assurance efforts.

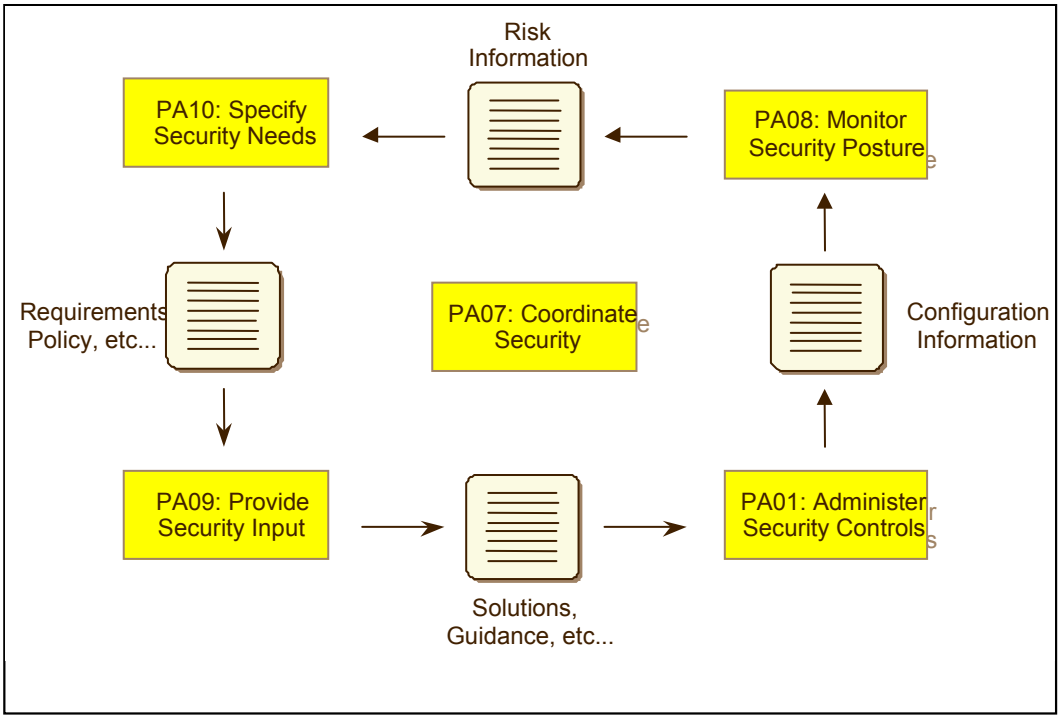

Figure 3 — Security is an integral part of the overall engineering process

Later in the lifecycle, the security engineer is called on to ensure that products and systems are properly configured in relation to the perceived risks, ensuring that new risks do not make the system unsafe to operate.

6.2.3 Assurance

Assurance is defined as the degree of confidence that security needs are satisfied [NIST94a]. It is a very important product of security engineering. There are many forms of assurance. The SSE-CMM® contributes to one aspect, the confidence in the repeatability of the results from the security engineering process. The basis for this confidence is that a mature organization is more likely to repeat results than an immature organization, see Figure 4. The detailed relationship between different forms of assurance is the subject of ongoing research.

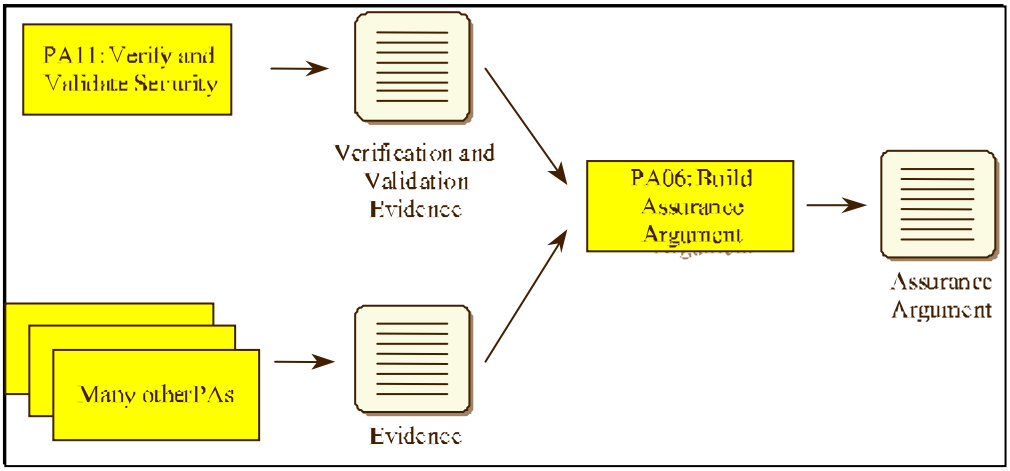

Figure 4 — The assurance process builds an argument establishing confidence

Assurance does not add any additional controls to counter risks related to security, but it does provide the confidence that the controls that have been implemented will reduce the anticipated risk.

Assurance can also be viewed as the confidence that the safeguards will function as intended. This confidence derives from the properties of correctness and effectiveness. Correctness can be view as the property that the safeguards, as designed, implement the requirements. Effectiveness can be viewed as the property that the safeguards provide security adequate to meet the customer's security needs. The strength of the mechanism also plays a part but is moderated by the level of protection and assurance being sought.

Assurance is often communicated in the form of an argument. The argument includes a set of claims about properties of the system. These claims are supported by evidence. The evidence is frequently in the form of documentation developed during the normal course of security engineering activities.

The SSE-CMM® activities themselves involve the production of assurance relevant evidence. For example, process documentation can indicate that the development has followed a well-defined and mature engineering process that is subject to continuous improvement. Security verification and validation play a large role in establishing the trustworthiness of a product or system.

Many of the example work products included within the process areas will contribute to, or form part of that evidence. Modern statistical process control suggests that higher quality and higher assurance products can be produced more cost effectively and repeatedly by focusing on the process used to produce them. The maturity of the organizational practices will influence and contribute to the process.

6.3 SSE-CMM® Architecture Description

The SSE-CMM® architecture is designed to enable a determination of a security engineering organization's process maturity across the breadth of security engineering. The goal of the architecture is to clearly separate basic characteristics of the security engineering process from its management and institutionalization characteristics. In order to ensure this separation, the model has two dimensions, called “domain” and “capability” which are described below.

Importantly, the SSE-CMM® does not imply that any particular group or role within an organization must do any of the processes described in the model. Nor does it require that the latest and greatest security engineering technique or methodology be used. The model does require, however, that an organization have a process in place that includes the basic security practices described in the model. The organization is free to create their own process and organizational structure in any way that meets their business objectives.

6.3.1 The Basic Model

The SSE-CMM® has two dimensions, “domain” and “capability”. The domain dimension is perhaps the easier of the two dimensions to understand. This dimension simply consists of all the practices that collectively define security engineering. These practices are called “base practices”. The structure and content of these base practices are discussed below.

The capability dimension represents practices that indicate process management and institutionalization capability. These practices are called “generic practices” as they apply across a wide range of domains. The generic practices represent activities that should be performed as part of doing base practices.

Figure 5 illustrates the relationship between base practices and generic practices. A fundamental part of security engineering is the identification of security vulnerabilities. This activity is captured in the SSE-CMM® in Base Practice 05.02, “Identify System Security Vulnerabilities.”

One way to determine an organization's ability to do something is to check whether they have a process for allocating resources to the activities they claim to be doing. This “characteristic” of mature organizations is reflected in the SSE-CMM® in Generic Practice 2.1.1, “Allocate Resources.”

Putting the base practice and generic practice together provides a way to check an organization's capability to perform a particular activity. Here an interested party might ask, “does your organization allocate resources for identifying system security vulnerabilities?” If the answer is “yes,” the interviewer learns a little about the organization's capability.

Answering all the questions raised by combining all the base practices with all the generic practices will provide a good picture of the security engineering capability of the organization in question.

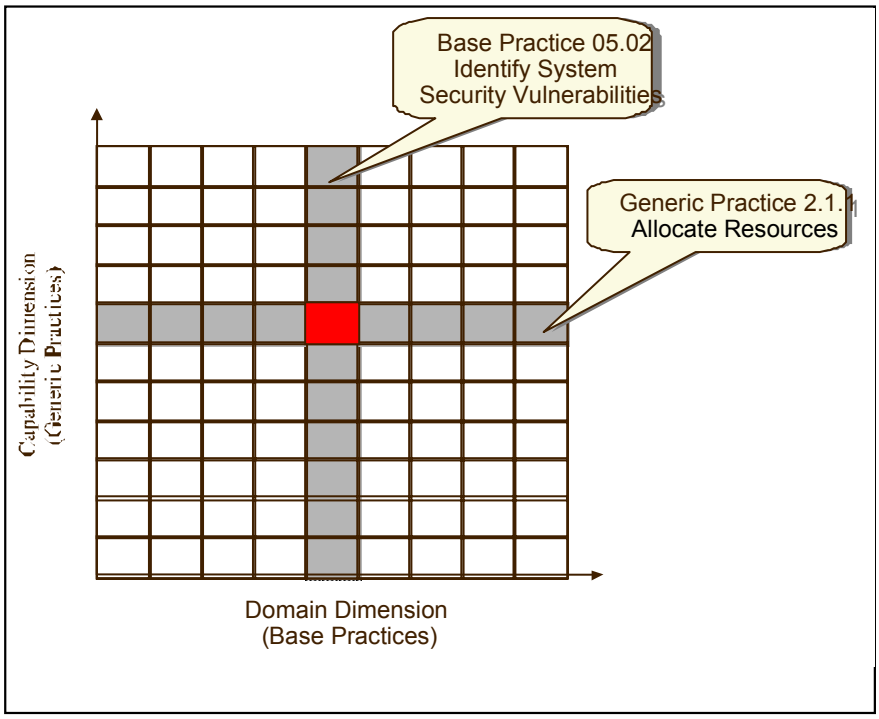

Figure 5 — The model evaluates each process area against each common feature.

6.3.2 The Base Practices

The SSE-CMM® contains 129 base practices, organized into 22 process areas. Of these, 61 base practices, organized in 11 process areas, cover all major areas of security engineering. The remaining 68 base practices, organized in 11 process areas, address the project and organization domains. They have been drawn from the Systems Engineering and Software CMM®. They are required to provide a context and support for the Systems Security Engineering process areas. The base practices for security were gathered from a wide range of existing materials, practice, and expertise. The practices selected represent the best existing practice of the security engineering community, not untested practices.

Identifying security engineering base practices is complicated by the many different names for activities that are essentially the same. Some of these activities occur later in the life cycle, at a different level of abstraction, or are typically performed by individuals in different roles. However, an organization cannot be considered to have achieved a base practice if it is only performed during the design phase or at a single level of abstraction. Therefore, the SSE-CMM® ignores these distinctions and identifies the basic set of practices that are essential to the practice of good security engineering.

A base practice:

- applies across the life cycle of the enterprise;
- does not overlap with other Base Practices;
- represents a “best practice” of the security community;
- does not simply reflect a state-of -the-art technique;
- is applicable using multiple methods in multiple business contexts; and
- does not specify a particular method or tool.

The base practices have been organized into process areas in a way that meets a broad spectrum of security engineering organizations. There are many ways to divide the security engineering domain into process areas. One might try to model the real world, creating process areas that match security engineering services. Other strategies attempt to identify conceptual areas that form fundamental security engineering building blocks. The SSE-CMM® compromises between these competing goals in the current set of process areas.

Each process area has a set of goals that represent the expected state of an organization that is successfully performing the process area. An organization that performs the base practices of the process area should also achieve its goals.

A process area:

- assembles related activities in one area for ease of use;
- relates to valuable security engineering services;
- applies across the life cycle of the enterprise;
- can be implemented in multiple organization and product contexts;
- can be improved as a distinct process;
- can be improved by a group with similar interests in the process; and
- includes all base practices that are required to meet the goals of the process area.

The eleven systems security engineering process areas of the SSE-CMM® are listed below. Note that they are listed in alphabetical order to discourage the notion that the process areas are ordered by lifecycle phase or area. These process areas and the base practices that define them are described in Clause 7, and listed below:

- PA01 Administer Security Controls;
- PA02 Assess Impact;
- PA03 Assess Security Risk;
- PA04 Assess Threat;
- PA05 Assess Vulnerability;
- PA06 Build Assurance Argument;
- PA07 Coordinate Security;
- PA08 Monitor Security Posture;
- PA09 Provide Security Input;
- PA10 Specify Security Needs; and
- PA11 Verify and Validate Security.

The SSE-CMM® also includes eleven process areas related to project and organizational practices. These process areas were adapted from the SE-CMM®. These process areas and the base practices that define them are described in Annex B, and listed below:

- PA12 - Ensure Quality;
- PA13 - Manage Configuration;
- PA14 - Manage Project Risk;
- PA15 - Monitor and Control Technical Effort;
- PA16 - Plan Technical Effort;
- PA17 - Define Organization's Systems Engineering Process;
- PA18 - Improve Organization's Systems Engineering Process;
- PA19 - Manage Product Line Evolution;
- PA20 - Manage Systems Engineering Support Environment;
- PA21 - Provide Ongoing Skills and Knowledge; and
- PA22 - Coordinate with Suppliers.

NOTE These PAs have been placed in an annex to facilitate future enhanced alignment with ISO/IEC 15288.

6.3.3 The Generic Practices

Generic practices are activities that apply to all processes. They address the management, measurement, and institutionalization aspects of a process. In general, they are used during an appraisal to determine the capability of an organization to perform a process.

Generic practices are grouped into logical areas called “Common Features” which are organized into five “Capability Levels” which represent increasing organizational capability. Unlike the base practices of the domain dimension, the generic practices of the capability dimension are ordered according to maturity. Therefore, generic practices that indicate higher levels of process capability are located at the top of the capability dimension.

The common features are designed to describe major shifts in an organization's characteristic manner of performing work processes (in this case, the security engineering domain). Each common feature has one or more generic practices. The lowest common feature is 1.1 Base Practices are Performed. This common feature simply checks whether an organization performs all the base practices in a process area.

Subsequent common features have generic practices that help to determine how well a project manages and improves each process area as a whole. The generic practices, described in Annex A, are grouped to emphasize any major shift in an organization's characteristic manner of doing security engineering. Table 1 lists some principles captured in the generic practices.

Table 1 — Capability dimension principles

Principle	How Expressed in SSE-CMM®
You have to do it before you can manage it	The Performed Informally level focuses on whether an organization performs a process that incorporates the base practices.
Understand what's happening on the project (where the products are!) before defining organizationwide processes.	The Planned and Tracked level focuses on projectlevel definition, planning and performance issues.
Use the best of what you've learned from your projects to create organizationwide processes.	The Well Defined level focuses on disciplined tailoring from defined processes at the organization level.
You can't measure it until you know what “it” is.	Although it is essential to begin collecting and using basic project measures early (i.e., at the Planned and Tracked level). Measurement and use of data is not expected organization wide until the Well Defined and particularly the Quantitatively Controlled levels have been achieved.
Managing with measurement is only meaningful when you're measuring the right things	The Quantitatively Controlled level focuses on measurements being tied to the business goals of the organization.
A culture of continuous improvement requires a foundation of sound management practice, defined processes, and measurable goals.	The Continuously Improving level gains leverage from all the management practice improvements seen in the earlier levels, then emphasizes the cultural shifts that will sustain the gains made.

The common features below represent the attributes of mature security engineering necessary to achieve each level. These common features and the generic practices that define them are described in Annex A.

Level 1:

- 1.1 Base Practices are Performed.

Level 2:

- 2.1 Planning Performance;
- 2.2 Disciplined Performance;

- 2.3 Verifying Performance; and
- 2.4 Tracking Performance.

Level 3:

- 3.1 Defining a Standard Process;
- 3.2 Perform the Defined Process; and
- 3.3 Coordinate Practices.

Level 4:

- 4.1 Establishing Measurable Quality Goals; and
- 4.2 Objectively Managing Performance.

Level 5:

- 5.1 Improving Organizational Capability; and
- 5.2 Improving Process Effectiveness.

The SSE-CMM® also does not imply specific requirements for performing the generic practices. An organization is generally free to plan, track, define, control, and improve their processes in any way or sequence they choose. However, because some higher level generic practices are dependent on lower level generic practices, organizations are encouraged to work on the lower level generic practices before attempting to achieve higher levels.

6.3.4 The Capability Levels

There is more than one way to group practices into common features and common features into capability levels. The following discussion addresses these common features.

The ordering of the common features stems from the observation that implementation and institutionalization of some practices benefit from the presence of others. This is especially true if practices are well established. Before an organization can define, tailor, and use a process effectively, individual projects should have some experience managing the performance of that process. Before institutionalizing a specific estimation process for an entire organization, for example, an organization should first attempt to use the estimation process on a project. However, some aspects of process implementation and institutionalization should be considered together (not one ordered before the other) since they work together toward enhancing capability.

Common features and capability levels are important both in performing an assessment and improving an organization's process capability. In the case of an assessment where an organization has some, but not all common features implemented at a particular capability level for a particular process, the organization usually is operating at the lowest completed capability level for that process. For example, an organization that performs all but one of the Level 2 generic practices for some process area should receive a Level 1 rating. An organization may not reap the full benefit of having implemented a common feature at any given capability level if the common features at lower capability levels have not been implemented. An assessment team should take this into account in assessing an organization's individual processes.

In the case of improvement, organizing the practices into capability levels provides an organization with an “improvement road map,” should it desire to enhance its capability for a specific process. For these reasons, the practices in the SSE-CMM® are grouped into common features, which are ordered by capability levels.

An assessment should be performed to determine the capability levels for each of the process areas. This indicates that different process areas can and probably will exist at different levels of capability. The

organization will then be able to use this process-specific information as a means to focus improvements to its processes. The priority and sequence of the organization's activities to improve its processes should take into account its business goals.

Business goals are the primary driver in interpreting a model such as the SSE-CMM®. But, there is a fundamental order of activities and basic principles that drive the logical sequence of typical improvement efforts. This order of activities is expressed in the common features and generic practices of the capability level side of the SSE-CMM® architecture.

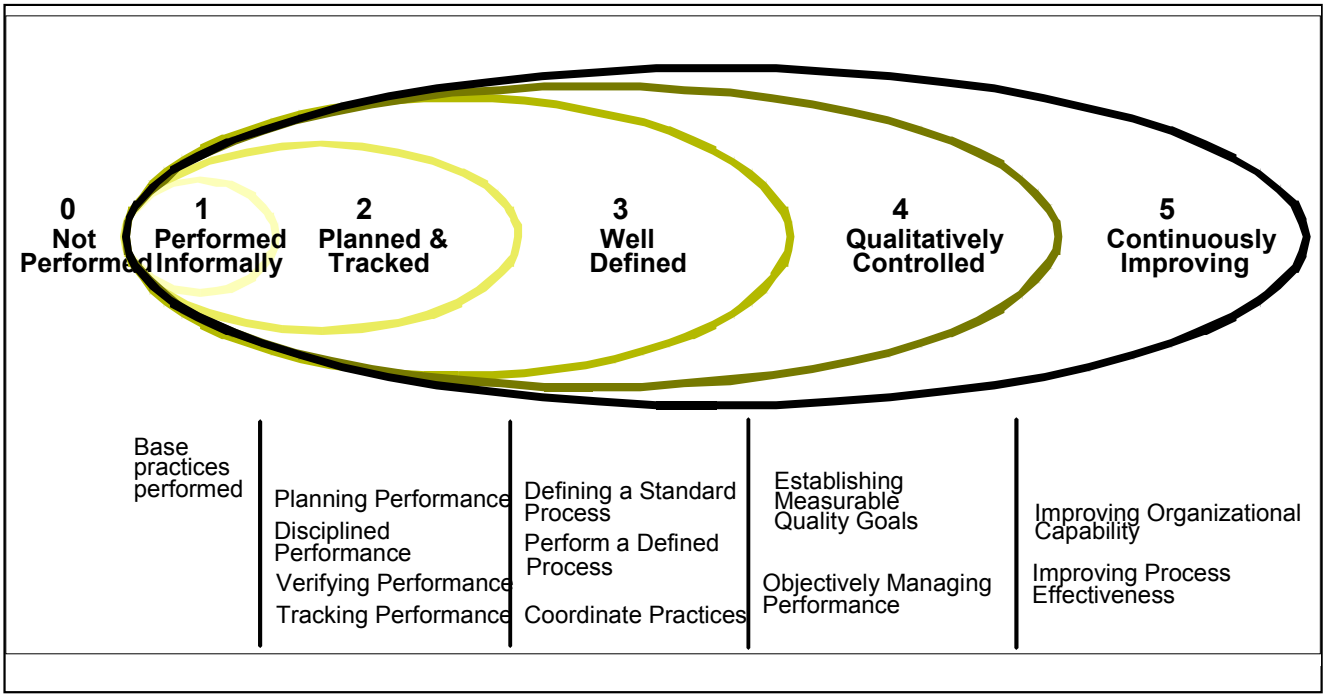

Figure 6 — Capability levels represent the maturity of security engineering organizations

The SSE-CMM® contains five levels, which are depicted in Figure 6, and detailed in Annex A.

6.3.5 Capability Dimension/Measurement Framework Mapping

The capability dimension of the SSE-CMM® and the measurement framework of ISO/IEC 15504-2 differ somewhat in terms of structure, but very little in terms of the detail and intent. In the case of the SSE-CMM® the capability dimension is organized into a number of “capability levels”. Each capability level is made up of a number of “common features”, which in turn are made up of one or more “generic practices”; see Figure 10. In the case of ISO/IEC 15504-2 measurement framework, this is made up of a number of “levels” with each level consisting of a number of process attributes (PA)s. The table below sets out a mapping of the capability levels of the SSE-CMM® to the levels of 155042.

Table 2 — Capability Dimension to Measurement Framework Mapping

SSE-CMM® Capability Dimension	155042 Measurement Framework
[Not explicitly defined in the SSE-CMM®, but implicitly inferred].	Level 0: Incomplete process
Capability Level 1 Performed Informally	Level 1: Performed process
Common Feature 1.1 Base Practices are performed	PA 1.1 Process performance attribute
Capability Level 2 Planned and Tracked	Level 2: Managed process
Common Feature 2.1 Planning Performance Common Feature 2.4 Tracking Performance	PA 2.1 Performance management attribute
Common Feature 2.2 Disciplined Performance Common Feature 2.3 Verifying Performance	PA 2.2 Work product management attribute
Capability Level 3 Well Defined	Level 3: Established process
Common Feature 3.1 Defining a Standard Process Common Feature 3.2 Performing the Defined Process	PA 3.1 Process definition attribute
[Not specifically addressed at this point, however these aspects are addressed earlier in the following GPs]. GP 2.1.1 Allocate Resources GP 2.1.2 Assign Responsibilities GP 2.1.5 Ensure Training	PA 3.2 Process resource attribute
Common Feature 3.3 Coordinate Practices	*[No direct equivalent]*.
Capability Level 4 Quantitatively Controlled	Level 4: Predictable process
Common Feature 4.1 Establishing Measurable Quality Goals	PA 4.1 Measurement attribute
Common Feature 4.2 Objectively Managing Performance	PA 4.2 Process control attribute
Capability Level 5 Continuously Improving	Level 5: Optimizing process
Common Feature 5.1 Improving Organization Capability	PA 5.2 Continuously improving attribute
Common Feature 5.2 Improving Process Effectiveness	PA 5.1 Process change attribute

6.3.6 Relationship to ISO/IEC 15288 - System Life Cycle Processes

This International Standard the SSE-CMM® has been developed outside the normal ISO/IEC environment. This means that some differences in the use of terminology and detail exist between ISO/IEC 21827 and ISO/IEC 15288. In addition, ISO/IEC 21827 is targeted at a different domain and discipline, systems security engineering, which inevitably, gives rise to some differences, which are minor and are noted where applicable. However, the underlying concepts and approaches used by both ISO/IEC 21827 and ISO/IEC 15288 are very similar.

Some examples of relationships include:

- ISO/IEC 21827 Process Areas relate directly to ISO/IEC 15288 Processes;
- ISO/IEC 21827 Base Practices relate directly to ISO/IEC 15288 Activities;
- ISO/IEC 21827 Work Products relate directly to ISO/IEC 15288 Outcomes; and
- ISO/IEC 21827 Process Descriptions are identical to ISO/IEC 15288 process descriptions.

Table 3, below, maps the major relationships of the Process Areas of ISO/IEC 21827 to the processes of ISO/IEC 15288.

NOTE 1 A row containing multiple "x" indicates that the particular process of ISO/IEC 15288 is covered in more than one process area of ISO/IEC 21827.

NOTE 2 A column containing multiple "x" indicates that the particular process area of ISO/IEC 21827 is covered in more than one process of ISO/IEC 15288.

Table 3 — ISO/IEC 21827 Process Areas to ISO/IEC 15288 Processes Relationship

21827 Process Areas to 15288 Processes Relationships																							
15288 Processes	21827 Process areas																						
	PA01	PA02	PA03	PA04	PA05	PA06	PA07	PA08	PA09	PA10	PA11	PA12	PA13	PA14	PA15	PA16	PA17	PA18	PA19	PA20	PA21	PA22	Rmk
Acquisition																						X	
Supply										X												X	
Environment Mgt	X																		X	X			
Investment Mgt																							NRE
System L-C Mgt																	X	X					
Resource Mgt																	X				X	X	
Project Planning																X							
Project Assessment															X								
Project Control												X			X								
Decision Making										X													
Risk Mgt														X									
Configuration Mgt													X										
Information Mgt						X	X																
Stakeholder Requ Def.										X													
Requirements Analysis			X						X	X	X												
Architecture Design									X														
Implementation																							NRE
Integration Verification											X												NRE
Transition																							NRE
Validation											X												
Operation								X											X				
Maintenance	X								X														
Disposal	X																						
Rmks		NRE		NRE	NRE										NRC = No real Equivalent								
Legend:		X	= A relationship exist between the Process Area and the Process																				

6.4 Summary Chart

This chart represents the model at a high level of abstraction. The practitioner is cautioned that each process area consists of a number of base practices, which are described in detail in Clause 7 and Annex B. Also, each common feature consists of a number of generic practices, which are described in detail in Annex A. It is up to each individual organization to select a combination of process areas to be applicable.

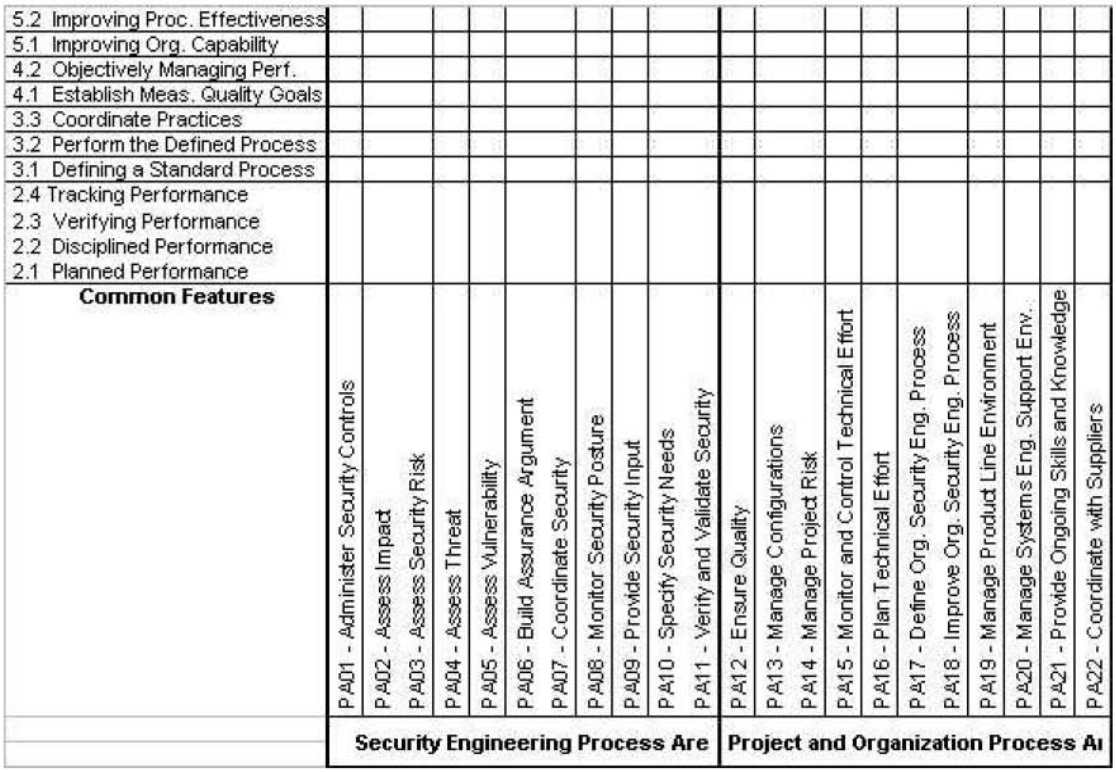

Figure 7 — Summary of Process Areas and Common Features relationships

7 Security Base Practices

This clause contains the practices considered essential to the conduct of basic security engineering (i.e., the base practices). Note that the process areas are numbered in no particular order since the SSE-CMM® does not prescribe a specific process or sequence.

An organization can be assessed against any one single process area or combination of process areas. The process areas together, however, are intended to cover all base practices for security engineering and there are many inter-relationships between the process areas. At present, the SSE-CMM® comprises 11 security process areas, each of which contains a number of base practices. Each process area is identified in the following subsections.

The general format of the process areas is shown in Figure 8. The summary description contains a brief overview of the purpose of the process area. Each process area is decomposed into a set of base practices. The base practices are considered mandatory items (i.e., they must be successfully implemented to accomplish the purpose of the process area they support). Each base practice is described in detail following the process area summary. Goals identify the desired end result of implementing the process area.

PA01 – Process Area Title (in verb-noun form)
Summary Description – An overview of the process area
Goals – A list indicating the desired results of implementing this process area
Base Practices List – A list showing the number and name of each base practice
Process Area Notes – Any other notes about this process area
BP.01.01 – Base Practice Title (in verb-noun form)
Descriptive Name – A sentence describing the base practice
Description – An overview of this base practice
Example Work Products – A list of examples illustrating some possible output
Notes – Any other notes about this base practice
BP.01.02...

Figure 8 — Process Area Format

7.1 PA01 Administer Security Controls

7.1.1 Process Area

7.1.1.1 Summary Description

The purpose of Administer Security Controls is to ensure that the intended security for the system that was integrated into the system design is in fact achieved by the resultant system in its operational state.

7.1.1.2 Goals:

- security controls are properly configured and used.

7.1.1.3 Base Practice List

BP.01.01 Establish responsibilities and accountability for security controls and communicate them to everyone in the organization.

BP.01.02 Manage the configuration of system security controls.

BP.01.03 Manage security awareness, training, and education programs for all users and administrators.

BP.01.04 Manage periodic maintenance and administration of security services and control mechanisms.

7.1.1.4 Process Area Notes

This process area addresses those activities required to administer and maintain the security control mechanisms for a development environment and an operational system. Further this process area helps to ensure that, over time, the level of security does not deteriorate. The management of controls for a new facility should integrate with existing facility controls.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.1.2 BP.01.01 - Establish Security Responsibilities

Establish responsibilities and accountability for security controls and communicate them to everyone in the organization.

7.1.2.1 Description

Some aspects of security can be managed within the normal management structure, while others require more specialized management.

The procedures should ensure that those charged with responsibility are made accountable and empowered to act. It should also ensure that whatever security controls are adopted are clear and consistently applied. In addition, they should ensure that whatever structure is adopted is communicated, not only to those within the structure, but also the whole organization.

7.1.2.2 Example Work Products:

- an organizational security structure chart - identifies the organization members related to security and their role;
- documents describing security roles - describe each of the organizational roles related to security and their responsibilities;
- documents describing security responsibilities - describe each of the security responsibilities in detail, including what output is expected and how it will be reviewed and used;
- documents detailing security accountabilities - describe who is accountable for security related problems, ensuring that someone is responsible for all risks; and
- documents detailing security authorizations - identify what each member of an organization is allowed to do.

7.1.2.3 Notes

Some organizations establish a security engineering working group which is responsible for resolving security related issues. Other organizations identify a security engineering lead who is responsible for making sure that the security objectives are attained.

7.1.3 BP.01.02 - Manage Security Configuration

Manage the configuration of system security controls.

7.1.3.1 Description

Security configuration of all devices requires management. This base practice recognizes that system security relies to a great extent on a number of interrelated components (hardware, software, and procedures) and that normal configuration management practices may not capture the interrelated dependencies required for secure systems.

7.1.3.2 Example Work Products:

- records of all software updates - tracks licenses, serial numbers, and receipts for all software and software updates to the system, including date, person responsible, and a description of the change;
- records of all distribution problems - contains a description of any problem encountered during software distribution and a description of how it was resolved;

- system security configuration - a database describing the current state of the system hardware, software, and communications, including their location, the individual assigned, and related information;

- system security configuration changes - a database describing any changes to the system security configuration, including the name of the person making the change, a description of the change, the reason for the change, and when the change was made;

- periodic summaries of trusted software distribution - describes recent trusted software distribution activity, noting any difficulties and action items;

- security changes to requirements - tracks any changes to system requirements made for security reasons or having an effect on security, to help ensure that changes and their effects are intentional;

- security changes to design documentation - tracks any changes to the system design made for security reasons or having an effect on security, to help ensure that changes and their effects are intentional;

- control implementation - describes the implementation of security controls within the system, including configuration details;

- security reviews - describe the current state of the system security controls relative to the intended control implementation; and

- control disposal - describes the procedure for removing or disabling security controls, including transition plans.

7.1.3.3 Notes

This BP includes the establishment of the security controls configurations, if required, however the actual task of configuring the security control is likely to be performed when the control is implemented. Maintaining currency of the configuration of security controls in any system is a complex task, particularly for a large distributed system. Some aspects of the configuration itself are of vital importance to the maintenance of security. Effective security requires the recording of certain information related to the security control mechanisms that make up the system and not normally used by other disciplines. Similarly, proposed changes to an existing system must be assessed to determine the impact on the overall system security posture.

Procedures are required, particularly in a distributed environment, to ensure that all copies of a particular module of software or application are the appropriate version, and are the same. In addition, particularly if the software is distributed over the network itself, it is essential to ensure that the software has not become corrupted in the distribution process. These requirements apply to all software.

This base practice should ensure that the software performs only those functions that are intended; a sealed reference version is maintained; all copies of the software are the same; updates are confirmed; and the security controls configuration is known and maintained.

7.1.4 BP.01.03 - Manage Security Awareness, Training, and Education Programs

Manage security awareness, training, and education programs for all users.

7.1.4.1 Description

The security awareness, training and education of all staff requires management in the same way that other awareness, training and education needs to be managed.

7.1.4.2 Example Work Products:

- user review of security training material - describes the effectiveness, applicability, and relevance of the security awareness and training material;

- logs of all awareness, training and education undertaken, and the results of that training - tracks user understanding of organizational and system security;

- periodic reassessments of the user community level of knowledge, awareness and training with regard to security - reviews the organizational understanding of security and identifies possible areas to focus on in the future; and

- catalogues of training, awareness and educational material - collection of security relevant training material which can be reused throughout an organization. Can be integrated with other organizational training materials.

7.1.4.3 Notes

In this context the term users is taken to include not only those individuals who work directly with the system, but also includes all individuals who receive information from the system, either directly or indirectly, plus all management.

It is vitally important that users are aware of the reasons that security is in place and the reasons for a particular security mechanism or control. In addition, it is essential that the users understand how to use the mechanism or control correctly. Thus users require initial, periodic refresher, and revised sessions when new mechanisms and controls are introduced. All users require security awareness, some users require training in the use of security mechanisms, and a few users require much more in depth security knowledge and are thus candidates for security education.

7.1.5 BP.01.04 - Manage Security Services and Control Mechanisms

Manage periodic maintenance and administration of security services and control mechanisms.

7.1.5.1 Description

The general management of security services and mechanisms is similar to other service and mechanism management. This includes the protection of the services and mechanisms from corruption, either accidental or deliberate, and appropriate archival in compliance with legal and policy requirements.

7.1.5.2 Example Work Products:

- maintenance and administrative logs - record of maintenance, integrity checks, and operational checks performed on system security mechanisms;

- periodic maintenance and administration reviews - contains analysis of recent system security administration and maintenance efforts;

- administration and maintenance failure - tracks problems with system security administration and maintenance in order to identify where additional effort is required;

- administration and maintenance exception - contains descriptions of exceptions made to the normal administration and maintenance procedures, including the reason for the exception and the duration of the exception;

- sensitive information lists - describes the various types of information in a system and how that information should be protected;

- sensitive media lists - describes the various types of media used to store information in a system and how each should be protected; and

- sanitization, downgrading, and disposal - describes procedures for ensuring that no unnecessary risks are incurred when information is changed to a lower sensitivity or when media are sanitized or disposed.

7.1.5.3 Notes

Some examples of these services are identification and authentication (I&A); access mediation/control; and key management.

Each of the security services must involve establishing appropriate security parameters, implementing those parameters, monitoring and analysing performance, and adjusting the parameters.

These requirements are particularly applicable to such security services as Identification and Authentication for the maintenance of users and authentication data, and access control for the maintenance of permissions.

Information assets, a subset of assets, are defined as the software, and data that belong to an organization. Some information assets may require the sensitive portions to be removed so that the remainder can be used for less sensitive purposes. Sanitization ensures that information is released to individuals who have a need to know. This may be achieved by downgrading the information or by selective removal of specific sensitive information.

Electronic media can retain residual traces of information even when it is overwritten with other information. Some media may need to be sanitized before it can be used for other less sensitive purposes. Once the useful life of magnetic media is complete it should be disposed of in a manner appropriate to the sensitivity of the residual information, which may necessitate the destruction of the media. Some communities do not permit the reuse of media for less sensitive information. The specific details of sanitization, downgrading, and disposal requirements are dependent upon the specific community and applicable regulations.

7.2 PA02 - Assess Impact

7.2.1 Process Area

7.2.1.1 Summary Description

The purpose of Assess Impact is to identify impacts that are of concern with respect to the system and to assess the likelihood of the impacts occurring. Impacts may be tangible, such as the loss of revenue or financial penalties, or intangible, such as loss of reputation or goodwill.

7.2.1.2 Goals:

- the security impacts of risks to the system are identified and characterized.

7.2.1.3 Base Practice List

BP.02.01 Identify, analyse, and prioritize operational, business, or mission capabilities leveraged by the system.

BP.02.02 Identify and characterize the system assets that support the key operational capabilities or the security objectives of the system.

BP.02.03 Select the impact metric to be used for this assessment,

BP.02.04 Identify the relationship between the selected measurements for this assessment and metric conversion factors if required,

BP.02.05 Identify and characterize impacts.

BP.02.06 Monitor ongoing changes in the impacts.

7.2.1.4 Process Area Notes

Impact is the consequence of an unwanted incident, caused either deliberately or accidentally, which affects the assets. The consequences could be the destruction of certain assets, damage to the IT system, and loss of confidentiality, integrity, availability, accountability, authenticity or reliability. Possible indirect consequences include financial losses, and the loss of market share or company image. The measurement of impacts permits a balance to be made between the results of an unwanted incident and the cost of the safeguards to protect against the unwanted incident. The frequency of occurrence of an unwanted incident needs to be taken into account. This is particularly important when the amount of harm caused by each occurrence is low but where the aggregate effect of many incidents over time may be harmful. The assessment of impacts is an important element in the assessment of risks and the selection of safeguards.

The impact information produced by this process area is intended for use in PA03, along with the threat information from PA04 and vulnerability information from PA05. While the activities involved with gathering threat, vulnerability, and impact information have been grouped into separate process areas, they are interdependent. The goal is to find combinations of threat, vulnerability, and impact that are deemed sufficiently risky to justify action. Therefore, the search for impacts should be guided to a certain extent by the existence of corresponding threats and vulnerabilities.

Since impacts are subject to change, they must be periodically monitored to ensure that the understanding generated by this process area is maintained at all times.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.2.2 BP.02.01 - Prioritize Capabilities

Identify, analyse, and prioritize operational, business, or mission capabilities leveraged by the system.

7.2.2.1 Description

Identify, analyse, and prioritize operational, business, or mission directives. The influence of the business strategies should also be considered. These will influence and moderate the impacts to which the organization may be subjected. This in turn is likely to influence the sequence in which risks are addressed in other base practices and process areas. It is therefore important to factor in these influences when the potential impacts are being examined. This base practice is related to the activities of PA10.

7.2.2.2 Example Work Products:

- system priority lists and impact modifiers; and
- system capability profile - describes the capabilities of a system and their importance to the objective of the system.

7.2.2.3 Notes

Functional and information assets can be interpreted to their value and criticality in the defined environment. Value can be the operational significance, classification, sensitivity level, or any other means of specifying the perceived value of the asset to the intended operation and use of the system. Criticality can be interpreted as the impact on the system operation, on human lives, on operational cost and other critical factors, when a leveraged function is compromised, modified, or unavailable in the operational environment. An asset's value may also be defined in relation to their applicable security requirements. For example, an asset's value may be defined as the confidentiality of a client list, the availability of interoffice communication, or the integrity of payroll information. Many assets are intangible or implicit, as opposed to explicit. The risk assessment method selected should address how capabilities and assets are to be valued and prioritized.

7.2.3 BP.02.02 - Identify System Assets

Identify and characterize the system assets that support the key capabilities or the security objectives of the system.

7.2.3.1 Description

Identify system resources and data necessary to support the security objectives or the key capabilities (operational, business, or mission functions) of the system. Define each of these assets by assessing the significance of each asset in providing such support within a defined environment.

7.2.3.2 Example Work Products:

- product asset analysis - contains an identification of the product assets and their significance to the operation of the system; and
- system asset analysis - contains an identification of the system assets and their significance to the operation of the system

7.2.3.3 Notes

Assets are broadly construed to include the people, environment, technology and infrastructure in a system. Assets also include data and resources. This includes not only information, but also systems (e.g., communication, data retrieval, applications, or printing resources). The importance of these assets can be defined as their significance to the value and criticality of the capabilities they support in the defined environment. In some cases, this practice is a review of the work from PA09 and PA11.

7.2.4 BP.02.03 - Select Impact Metric(s)

Select the impact metric(s) to be used for this assessment.

7.2.4.1 Description

A number of measurements can be used to measure the impact of an event. It is advantageous to predetermine which measurements will be used for the particular system under consideration.

7.2.4.2 Example Work Products:

- selected impact measurements.

7.2.4.3 Notes

A limited set of consistent measurements minimizes the difficulty in dealing with divergent measurements. Quantitative and qualitative measurements of impact can be achieved in a number of ways, such as:

- establishing the financial cost;
- assigning an empirical scale of severity, (e.g., 1 through 10); and
- the use of adjectives selected from a predefined list, (e.g., low, medium, high).

7.2.5 BP.02.04 - Identify Metric Relationship

Identify the relationship between the selected measurements for this assessment and metric conversion factors if required.

7.2.5.1 Description

Some impacts may need to be assessed using different measurements. The relationship between different measurements needs to be established to ensure a consistent approach for all exposures throughout the impact assessment. “Exposure” refers to a combination of a threat, vulnerability, and impact that could cause significant harm. In some cases it will be necessary to combine measurements to be able to produce a single consolidated result. Thus an approach for consolidation needs to be established. This will usually vary on a system to system basis. When qualitative measurements are in use, rules also need to be established to guide the combination of qualitative factors during the consolidation phase.

7.2.5.2 Example Work Products:

- impact metric relationships lists - describes the relationships between the measurements; and
- impact metric combination rules - describes the rules for combining impact measurements.

7.2.5.3 Notes

As an example if the exposure was to a meteor destroying a house, one potential impact might be the cost to rebuild the house, 100,000 US dollars. Another impact might be the loss of shelter until the house can be rebuilt, 6 months. These two impacts can be combined if the cost of shelter per month is established, 250 US dollars per month. The total impact for this exposure would then be 101,500 US dollars.

7.2.6 BP.02.05 - Identify and Characterize Impacts

Identify and characterize the impacts of unwanted incidents with either multiple measurements or consolidated measurements as appropriate.

7.2.6.1 Description

Starting with the assets and capabilities identified in BP.02.01 and BP.02.02, identify the consequences that would cause harm. For each asset, these might include unauthorised disclosure, modification, loss and/or destruction. Impacts to capabilities might include interruption, delay, or reduced resilience.

Once a relatively complete list has been created, the impacts can be characterized using the measurements identified in BP.02.03 and BP.02.04. This step may require some research into actuarial tables, almanacs, or other sources. The uncertainty in the measurements should also be captured and associated with each impact.

7.2.6.2 Example Work Products:

- exposure impact lists - a list of potential impacts and the associated measurements.

7.2.6.3 Notes

The impact assessment is performed based on the impact measurements determined in BP.02.03 and the impacts are combined based on the rules established in BP.02.04. In most cases there will be some uncertainty associated with the measurements and likelihood that a specific impact will occur within the specified environment. It is generally more effective to keep the factors of uncertainty separate so that when actions are taken to refine the working data it can be seen whether the refinement is to data itself or the uncertainty associated with the data.

7.2.7 BP.02.06 - Monitor Impacts

Monitor ongoing changes in the impacts.

7.2.7.1 Description

The impacts applicable to any location and situation are dynamic. New impacts can become relevant and the characteristics of existing impacts can change. It is therefore important to monitor both existing impacts and to check for the potential for new impacts on a regular basis. This base practice is closely linked to the generalized monitoring activity in BP.08.02.

7.2.7.2 Example Work Products:

- impact monitoring reports - describes the results of monitoring impacts; and
- impact change reports - describes changes to impacts.

7.2.7.3 Notes

Because impacts can change, the impact assessment activity should be iterative and should be conducted multiple times in the defined environments. However, impact assessment repetition should not supplant impact monitoring.

7.3 PA03 - Assess Security Risk

7.3.1 Process Area

7.3.1.1 Summary Description

The purpose of Assess Security Risk is to identify, analyse and evaluate the security risks involved with relying on a system in a defined environment. This process area focuses on ascertaining these risks based on an established understanding of how capabilities and assets are vulnerable to threats. Specifically, this activity involves identifying and assessing the likelihood of the occurrence of exposures. This set of activities is performed any time during a system's life cycle to support decisions related to developing, maintaining, or operating the system within a known environment.

7.3.1.2 Goals:

- an understanding of the security risk associated with operating the system within a defined environment is achieved; and
- risks are prioritized according to a defined methodology.

7.3.1.3 Base Practice List

BP.03.01 Select the methods, techniques, and criteria by which security risks for the system in a defined environment are identified, analysed, evaluated, and compared.

BP.03.02 Identify threat/vulnerability/impact triples (exposures),

BP.03.03 Assess the risk associated with the occurrence of an exposure.

BP.03.04 Assess the total uncertainty associated with the risk for the exposure.

BP.03.05 Order risks by priority.

BP.03.06 Monitor ongoing changes in the risk spectrum and changes to their characteristics.

7.3.1.4 Process Area Notes

Security risk is the likelihood that the impact of an unwanted incident will be realized. While related to project risks involving cost and schedule, security risk deals specifically with protection against impacts to the assets and capabilities of a system.

Risk estimates always include a factor of uncertainty, which will vary dependent upon a particular situation. This means that the likelihood can only be predicted within certain limits. In addition, the impact assessed for a particular risk also has associated uncertainty, as the unwanted incident may not turn out as expected. Thus the majority of factors have uncertainty as to the accuracy of the predictions associated with them. In many cases these uncertainties may be large. This makes planning and the justification of security very difficult.

Anything that can reduce the uncertainty associated with a particular situation is of considerable importance. For this reason, assurance is important as it indirectly reduces the risk of the system.

The risk information produced by this process area depends on the threat information from PA04, vulnerability information from PA05, and impact information from PA02. While the activities involved with gathering threat, vulnerability, and impact information have been grouped into separate process areas, they are interdependent. The goal is to find combinations of threat, vulnerability, and impact that are deemed sufficiently risky to justify action. This information forms the basis for the definition of security need in PA10 and the security input provided by PA09.

Since risk environments are subject to change, they must be periodically monitored to ensure that the understanding of risk generated by this process area is maintained at all times.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.3.2 BP.03.01 - Select Risk Analysis Method

Select the methods, techniques, and criteria by which security risks for the system in a defined environment are identified, analysed, evaluated, compared, and prioritized.

7.3.2.1 Description

This base practice consists of defining the method for identifying security risks for the system in a defined environment in a way that permits them to be identified analysed, evaluated, and compared. This should include a scheme for categorizing and prioritizing the risks based on threats, operational functions, established system vulnerabilities, potential loss, security requirements, or areas of concern.

7.3.2.2 Example Work Products:

- risk identification method describes the approach for identifying risks;
- risk assessment method - describes the approach for analysing and evaluating risks; and
- risk assessment formats - describes the format in which risks will be documented and tracked, including a description, significance, and dependencies.

7.3.2.3 Notes

Method can be an existing one, tailored one, or one specific to the operational aspects and defined environment for the system. The methodology used for the risk assessment should interface with the methodologies selected for the threat, vulnerability, and impact assessments.

7.3.3 BP.03.02 - Exposure Identification

Identify threat/vulnerability/impact triples (exposures).

7.3.3.1 Description

The purpose of identifying the exposures is to recognize which of the threats and vulnerabilities are of concern and to identify the impact of an occurrence of the threat and vulnerability. These are the exposures that will need to be considered in the selection of safeguards to protect the system.

7.3.3.2 Example Work Products:

- system exposure lists - describes the exposures of the system.

7.3.3.3 Notes

This base practice depends on the outputs of the threats, vulnerability, and risk process areas.

7.3.4 BP.03.03 - Assess Exposure Risk

Assess the risk associated with each exposure.

7.3.4.1 Description

Determine the consequences and likelihood of occurrence for each exposure, combine these values to produce a risk estimate, and evaluate the risk against pre-determined criteria.

7.3.4.2 Example Work Products:

- exposure risk list - a list of the calculated risks.

7.3.4.3 Notes

The likelihood of an exposure is a combination of the likelihood of the threat and the likelihood of the vulnerability. In many cases the likelihood of a specific magnitude or generalized magnitude, or the severity of impact, must also be factored in. In all cases there will be uncertainty associated with measurements. It is more effective to keep the factors of uncertainty separate so that when actions are taken to refine the working data it can be seen whether the refinement is to the data itself or the uncertainty associated with the data. This can often impact the strategies adopted to address the risks. This base practice makes use of the likelihood data gathered in BP.04.05, BP.05.03 and BP.02.05 to assess impact of the realization of an exposure with either multiple measurements or consolidated measurements as appropriate.

7.3.5 BP.03.04 - Assess Total Uncertainty

Assess the total uncertainty associated with the risk for the exposure.

7.3.5.1 Description

Each risk will have uncertainty associated with it. The total risk uncertainty is a cumulation of the uncertainties that have been identified for the threats, vulnerabilities, and impacts and their characteristics in BP.04.05, BP.05.03 and BP.02.05. This base practice is closely associated with the activities of PA06 as assurance can be used to modify and in some cases reduce uncertainty.

7.3.5.2 Example Work Products:

- exposure risk with associated uncertainty - a list of risks showing the measure of risk along with a measure of the uncertainty.

7.3.5.3 Notes

If uncertainty is not kept separate from the likelihood of an occurrence of an exposure then safeguards may well be implemented that will not achieve the benefit perceived or risk may be mitigated when in fact there was no need to do so.

7.3.6 BP.03.05 - Prioritize Risks

Order risks by priority.

7.3.6.1 Description

The risks that have been identified should be ordered based on the organization priorities, likelihood of occurrence, uncertainty associated with them and funds available. A risk can be mitigated, avoided, transferred or accepted. Combinations of these can also be used. The mitigation can address the threat, vulnerability, impact, or the risk itself. Actions should be selected with due regard to the stakeholders needs as identified in PA10, business priorities, and the overall system architecture.

7.3.6.2 Example Work Products:

- risk priority list - a list prioritizing the risks;
- safeguard requirement lists - lists of potential safeguards that can help mitigate the risks; and
- rationale for prioritization - a description of the prioritization scheme.

7.3.6.3 Notes

This step can be highly complex and often requires multiple iteration. Safeguards may address multiple risks, or multiple threats, vulnerabilities and impacts. This aspect can have the effect of changing the effective ordering of the risks to be addressed. Therefore, this process area is closely related to PA10 and PA09.

7.3.7 BP.03.06 - Monitor Risks and Their Characteristics

Monitor ongoing changes in the risk spectrum and changes to their characteristics.

7.3.7.1 Description

The risk spectrum applicable to any location and situation is dynamic. New risks can become relevant and the characteristics of existing risks can change. It is therefore important to monitor both existing risks and their characteristics, and to check for new risks on a regular basis. This base practice is closely linked to the generalized monitoring activity in BP.08.02.

7.3.7.2 Example Work Products:

- risk monitoring reports - reports describing the current risk spectrum; and
- risk change reports - describes the operational capabilities of a system and their importance to the objective of the system.

7.3.7.3 Notes

Because risks can change, the risk assessment activity should be conducted multiple times in the defined environments. However, risk assessment repetition should not supplant risk monitoring. Note that the term “spectrum” is used to denote new risks, and the term “characteristics” refers to the properties of existing identified risks.

7.4 PA04 - Assess Threat

7.4.1 Process Area

7.4.1.1 Summary Description

The purpose of the Assess Threat process area is to identify security threats and their properties and characteristics.

7.4.1.2 Goals:

- threats to the security of the system are identified and characterized.

7.4.1.3 Base Practice List

BP.04.01 Identify applicable threats arising from a natural source.

BP.04.02 Identify applicable threats arising from man-made sources, either accidental or deliberate.

BP.04.03 Identify appropriate units of measure, and applicable ranges, in a specified environment.

BP.04.04 Assess capability and motivation of threat agent for threats arising from man-made sources.

BP.04.05 Assess the likelihood of an occurrence of a threat event.

BP.04.06 Monitor ongoing changes in the threat spectrum and changes to their characteristics.

7.4.1.4 Process Area Notes

Many approaches and methodologies can be used to perform a threat assessment. An important consideration for determining which methodology to use is how it will interface and work with the methodologies used in other parts of the chosen risk assessment process.

The threat information produced by this process area is intended for use in PA03, along with the vulnerability information from PA05 and impact information from PA02. While the activities involved with gathering threat, vulnerability, and impact information have been grouped into separate process areas, they are interdependent. The goal is to find combinations of threat, vulnerability, and impact that are deemed sufficiently risky to justify action. Therefore, the search for threats should be guided to a certain extent by the existence of corresponding vulnerabilities and impacts.

Since threats are subject to change, they must be periodically monitored to ensure that the understanding generated by this process area is maintained at all times.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.4.2 BP.04.01 - Identify Natural Threats

Identify applicable threats arising from a natural source.

7.4.2.1 Description

Threats arising from natural sources include earthquakes, tsunami, and tornadoes. However, not all natural based threats can occur in all locations. For example it is not possible for a tsunami to occur in the centre of a large continent. Thus it is important to identify which natural based threats can occur in a specific location.

7.4.2.2 Example Work Products:

- applicable natural threat tables - tables documenting the character and likelihood of natural threats.

7.4.2.3 Notes

Much of the information required for this assessment can be obtained from actuarial lists and natural phenomena occurrence databases. While this information is valuable, it should be used with caution as it may be highly generalized and therefore may need to be interpreted to address the specific environment.

7.4.3 BP.04.02 - Identify Man-made Threats

Identify applicable threats arising from man-made sources, either accidental or deliberate.

7.4.3.1 Description

Threats arising from man-made sources require a somewhat different type of approach. There are basically two types of man-made threats: those that arise from accidental sources and those that result from a deliberate act. Some man-made threats may not be applicable in the target environment. These should be eliminated from further considerations in the analysis.

7.4.3.2 Example Work Products

- threat scenario descriptions - descriptions of how the threat works; and
- threat severity estimates - measurements of likelihood associated with a threat.

7.4.3.3 Notes

In some cases, to aid in the understanding of a deliberate threat it can be helpful to develop a scenario describing how the threat might occur. Use of generic man made threat databases should be assessed for completeness and relevancy.

7.4.4 BP.04.03 - Identify Threat Units of Measure

Identify appropriate units of measure, and applicable ranges, in a specified environment.

7.4.4.1 Description

The majority of natural threats and many man-made threats have units of measure associated with them. An example is the Richter scale for earthquakes. In most cases the total range of the unit of measure will not be applicable in a particular location. It is therefore appropriate to establish the maximum, and in some cases the minimum, magnitude or frequency of an event that can occur in the particular location under consideration.

7.4.4.2 Example Work Products:

- threat table with associated units of measure and location ranges.

7.4.4.3 Notes

In cases where a unit of measure for a particular threat does not exist an acceptable unit of measure should be created that is specific to the location. The associated range, if applicable, and the unit of measure should be described in testable terms.

7.4.5 BP.04.04 - Assess Threat Agent Capability

Assess capability and motivation of threat agent for threats arising from man-made sources.

7.4.5.1 Description

This process area focuses on the determination of a potential human adversary's ability and capability of executing a successful attack against the system. Ability addresses the adversaries knowledge of attacks (e.g., do they have the training/knowledge). Capability is a measure of the likelihood that an able adversary can actually execute the attack (e.g., do they have the resources).

7.4.5.2 Example Work Products:

- threat agent descriptions - capability assessments and descriptions.

7.4.5.3 Notes

Deliberate man-made threats are to a large extent dependent upon the capability of the threat agent and the resources that the threat agent has at their disposal. Thus a relatively inexperienced hacker who has access to the hacking tools of much more experienced and capable hackers, is a much more dangerous threat, but not as dangerous as the experienced hacker themselves. However, the inexperienced hacker may well cause unintended damage which the experienced hacker is less likely to do. In addition to the agent capability, an assessment of the resources that the agent has available should be considered along with their motivation for performing the act which may be affected by the agent's likely assessment of the attractiveness of the target (asset).

A threat agent may use multiple attacks in sequence or concurrently to achieve the desired goal. The effect of multiple attacks occurring in sequence or concurrently needs to be considered. The development of scenarios can assist in performing this task.

7.4.6 BP.04.05 - Assess Threat Likelihood

Assess the likelihood of an occurrence of a threat event.

7.4.6.1 Description

Assess how likely a threat event is to occur. Many factors need to be considered in making this assessment ranging from the chance occurrence of a natural event to the deliberate or accidental act of an individual. Many of the factors to be considered do not lend themselves to calculation or measurement. A consistent metric for reporting is desirable.

7.4.6.2 Example Work Products:

- threat event likelihood assessment - report describing the likelihood of threat events.

7.4.6.3 Notes

This is a complicated probability calculation as, many of the factors involve varying probabilities. Associated with any estimate of likelihood is a factor of uncertainty as to the accuracy and validity of that assessment. The uncertainty of the assessed likelihood should be reported separately to reduce potential confusion. In all cases there will be uncertainty associated with the measurements and likelihoods. It is normally more effective to keep the factors of uncertainty, which is also a compound expression, separate so that when actions are taken to refine the working data it can be seen whether the refinement is to the data itself or to the uncertainty associated with the data.

7.4.7 BP.04.06 - Monitor Threats and Their Characteristics

Monitor ongoing changes in the threat spectrum and changes to their characteristics.

7.4.7.1 Description

The threat spectrum applicable to any location and situation is dynamic. New threats can become relevant and the characteristics of existing threats can change. It is therefore important to monitor both existing threats and their characteristics, and to check for new threats on a regular basis. This base practice is closely linked to the generalized monitoring activity in BP.08.02.

7.4.7.2 Example Work Products:

- threat monitoring reports - documents describing the results of the threat monitoring effort; and
- threat change reports - documents describing changes in the threat spectrum.

7.4.7.3 Notes

Because threats can change, the threat assessment activity should be conducted multiple times in the defined environments. However, threat assessment repetition does not supplant threat monitoring.

7.5 PA05 - Assess Vulnerability

7.5.1 Process Area

7.5.1.1 Summary Description

The purpose of Assess Vulnerability is to identify and characterize system security vulnerabilities. This process area includes analysing system assets, defining specific vulnerabilities, and providing an assessment of the overall system vulnerability. The terms associated with security risk and vulnerability assessment are used differently in many contexts. For the purposes of this model, “vulnerability” refers to an aspect of a system that can be exploited for purposes other than those originally intended, weaknesses, security holes, or implementation flaws within a system that are likely to be attacked by a threat. These vulnerabilities are independent of any particular threat instance or attack. This set of activities is performed any time during a system's life-cycle to support the decision to develop, maintain, or operate the system within the known environment.

7.5.1.2 Goals:

- an understanding of system security vulnerabilities within a defined environment is achieved.

7.5.1.3 Base Practice List

BP.05.01 Select the methods, techniques, and criteria by which security system vulnerabilities in a defined environment are identified and characterized.

BP.05.02 Identify system security vulnerabilities.

BP.05.03 Gather data related to the properties of the vulnerabilities.

BP.05.04 Assess the system vulnerability and aggregate vulnerabilities that result from specific vulnerabilities and combinations of specific vulnerabilities.

BP.05.05 Monitor ongoing changes in the applicable vulnerabilities and changes to their characteristics.

7.5.1.4 Process Area Notes

The analyses and practices associated with this process area are often “paper-studies”. Discovery of system vulnerabilities by active tools and techniques is another method that supplements but does not replace other vulnerability analysis techniques. These active techniques may be viewed as a specialized form of vulnerability analysis. This type of analysis can be useful when trying to validate the security vulnerability of a system after a significant system upgrade, or to identify security vulnerabilities when two systems are interconnected. Active vulnerability analysis is needed in some cases to validate the security posture of a system and to increase the perception and understanding of existing security vulnerabilities. Active vulnerability analysis, sometimes referred to as penetration testing, is a process in which security engineers attempt to circumvent the security features of the system. The security engineers typically work under the same constraints applied to ordinary users but may be assumed to use all design and implementation documentation. The process of attacking security is not exhaustive and it is constrained by limited resources (time, money, personal, etc.).

The vulnerability information produced by this process area is intended for use in PA03, along with the threat information from PA04 and impact information from PA02. While the activities involved with gathering threat, vulnerability, and impact information have been grouped into separate process areas, they are interdependent. The goal is to find combinations of threat, vulnerability, and impact that are deemed sufficiently risky to justify action. Therefore, the search for vulnerabilities should be guided to a certain extent, by the existence of corresponding threats and impacts.

Since vulnerabilities are subject to change, they must be periodically monitored to ensure that the understanding generated by this process area is maintained at all times.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.5.2 BP.05.01 - Select Vulnerability Analysis Method

Select the methods, techniques, and criteria by which system security vulnerabilities in a defined environment are identified and characterized.

7.5.2.1 Description

This base practice consists of defining the method for establishing security vulnerabilities for the system in a way that permits them to be identified and characterized. This may include a scheme for categorizing and prioritizing the vulnerabilities based on threats and their likelihood, operational functions, security requirements, or other areas of concern when provided. Identifying the depth and breadth of the analysis allows the security engineers and the customer to determine target systems to be part of the exercise and its comprehensiveness. Analysis should be performed within the framework of a known and recorded configuration during a prearranged and specified time period. The methodology for the analysis should included expected results. Specific objectives for the analysis should be clearly stated.

7.5.2.2 Example Work Products:

- vulnerability analysis method - identifies the approach for finding and addressing system security vulnerabilities, including the analysis, reporting, and tracking process;
- vulnerability analysis formats - describes the format of the results of a vulnerability analysis to ensure a standardized approach;
- attack methodology and philosophy - includes objectives and the approach for performing the attack testing;
- attack procedures - detailed steps for performing the attack testing;
- attack plans - includes resources, schedule, description of the attack methodology;

- penetration study - the analysis and implementation of attack scenarios targeted at identifying unknown vulnerabilities; and

- attack scenarios - description of the specific attacks that will be attempted.

7.5.2.3 Notes

The vulnerability analysis method can be an existing, tailored, or one specific to the operational aspects and defined environment for the system. It often is based on or compliments the risk analysis methodology selected in PA03. Note that understandings about threats, capabilities, and value may not be provided, in which case the methodology must either narrow its scope or adopt a set of suitable assumptions.

The method used to analyse the vulnerabilities may be qualitative or quantitative. Often, analysis of vulnerabilities includes a reflection of likelihood that the vulnerability exists. Attack results can be conveyed in written report but attacks may also be demonstrated in a presentation.

At least two fundamentally different approaches exist for the identification of vulnerabilities. These two approaches are characterized as analysis based approaches or testing based approaches. Testing based approaches are good for identifying vulnerabilities that are present and for which there is a known threat which is included in the test sets. Analysis based approaches are best for identifying new vulnerabilities and those that are not immediately available for exploitation, but which can be available once another problem has been exploited. Other options that should be considered when selecting a vulnerability methodology include qualitative or quantitative based approaches. The ability to control the completeness of the analysis or testing should also be considered.

7.5.3 BP.05.02 - Identify Vulnerabilities

Identify system security vulnerabilities.

7.5.3.1 Description

System vulnerabilities may be found in both security and non-security related parts of the system. In many cases, non-security mechanisms that support security functions or work in concert with security mechanisms are found to have exploitable vulnerabilities. The methodology of attack scenarios as developed in BP.05.01 should be followed to the extent that vulnerabilities are validated. All system vulnerabilities discovered should be recorded.

7.5.3.2 Example Work Products:

- vulnerability list describes the vulnerability of the system to various attacks; and

- penetration profile includes results of the attack testing (e.g., vulnerabilities).

7.5.3.3 Notes

In this practice, vulnerabilities are seen as inherent to the system without consideration of the likelihood of any threats. The ordering of such vulnerabilities may be prioritized in accordance with threat analysis. Attacks that are not reproducible make the task of developing countermeasures difficult.

Vulnerabilities are identified in part based on prioritized risks from PA03, and the business priorities and objectives identified in PA10. In addition the assets considered in PA02 need to be taken into account.

7.5.4 BP.05.03 - Gather Vulnerability Data

Gather data related to the properties of the vulnerabilities.

7.5.4.1 Description

Vulnerabilities have properties associated with them. The intent of this base practice is to gather data associated with those properties. In some cases a vulnerability may have Units of Measure similar to those associated with threats, see BP.04.03. The ease with which the vulnerability can be exploited and the likelihood that the vulnerability exists should be identified and gathered.

7.5.4.2 Example Work Products:

- vulnerability property tables - tables that document the characteristics of vulnerabilities of the product or system.

7.5.4.3 Notes

Much of the data gathered during this activity will be used later to perform PA03. It is thus important that the data is gathered and stored in a format that will be usable by PA03. In all cases there will be uncertainty associated with the measurements and likelihoods. It is normally more effective to keep the uncertainty separate so that when actions are taken to refine the working data it can be seen whether the refinement is to the data itself or the uncertainty associated with the data.

7.5.5 BP.05.04 - Synthesize System Vulnerability

Assess the system vulnerability and aggregate vulnerabilities that result from specific vulnerabilities and combinations of specific vulnerabilities.

7.5.5.1 Description

Analyse which vulnerabilities or combination of vulnerabilities result in problems for the system. Analysis should identify additional characteristics of the vulnerability, such as the likelihood of vulnerability exploitation and the chance for successful exploitation. Recommendations for addressing the synthesized vulnerabilities may also be included in the results.

7.5.5.2 Example Work Products:

- vulnerability assessment report - includes a quantitative or qualitative description of the vulnerabilities that result in a problem for the system, including the likelihood of attack, likelihood of success, and the impact of the attack; and

- attack reports - documents the results and analysis of the results including vulnerabilities found, their potential for exploitation, and recommendations.

7.5.5.3 Notes

Results of an analysis and attack exercise need to be captured. Any vulnerabilities found and their potential for exploitation need to be identified and documented in sufficient detail to allow the customer to make decisions about countermeasures.

7.5.6 BP.05.05 - Monitor Vulnerabilities and Their Characteristics

Monitor ongoing changes in the applicable vulnerabilities and changes to their characteristics.

7.5.6.1 Description

The vulnerability spectrum applicable to any location and situation is dynamic. New vulnerabilities can become relevant and the characteristics of existing vulnerabilities can change. It is therefore important to monitor both existing vulnerabilities and their characteristics, and to check for new vulnerabilities on a regular basis. This base practice is closely linked to the generalized monitoring activity in BP.08.02.

7.5.6.2 Example Work Products:

- vulnerability monitoring reports - documents describing the results of the vulnerability monitoring effort; and
- vulnerability change reports - documents describing new or changed vulnerabilities.

7.5.6.3 Notes

Because vulnerabilities can change, the vulnerability assessment activity should be conducted multiple times in the defined environments. However, this should vulnerability assessment repetition should not supplant vulnerability monitoring.

7.6 PA06 - Build Assurance Argument

7.6.1 Process Area

7.6.1.1 Summary Description

The purpose of Build Assurance Argument is to clearly convey that the customer's security needs are met. An assurance argument is a set of stated assurance objectives that are supported by assurance evidence that may be derived from multiple sources and levels of abstraction.

This process includes identifying and defining assurance related requirements; evidence production and analysis activities; and additional evidence activities needed to support assurance requirements. Additionally, the evidence generated by these activities is gathered, packaged, and prepared for presentation.

7.6.1.2 Goals:

- the work products and processes clearly provide the evidence that the customer's security needs have been met.

7.6.1.3 Base Practice List

BP.06.01 Identify the security assurance objectives.

BP.06.02 Define a security assurance strategy to address all assurance objectives.

BP.06.03 Define measures to monitor security assurance objectives.

BP.06.04 Identify and control security assurance evidence.

BP.06.05 Perform analysis of security assurance evidence.

BP.06.06 Provide a security assurance argument that demonstrates the customer's security needs are met.

7.6.1.4 Process Area Notes

Activities involved in building an assurance argument include managing the identification, planning, packaging, and presentation of security assurance evidence.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied.

7.6.2 BP.06.01 - Identify Assurance Objectives

Identify the security assurance objectives.

7.6.2.1 Description

Assurance objectives, as determined by the customer, identify the level of confidence needed in the system. The system security assurance objectives specify a level of confidence that the system security policy is enforced. Adequacy of the objectives is determined by the developer, integrator, customer, and those who will approve the operation of the system, if any.

Identification of new, and modification to existing, security assurance objectives are coordinated with all security-related groups internal to the engineering organization and groups external to the engineering organization (e.g., customer, systems security certifier, user).

The security assurance objectives are updated to reflect changes. Examples of changes requiring a modification in security assurance objectives include changes in the level of acceptable risk by the customer, system security certifier, or user, or changes in the requirements or interpretations of the requirements.

Security assurance objectives must be communicated so as to be unambiguous. Applicable interpretations are included or developed if necessary.

7.6.2.2 Example Work Products:

- statement of security assurance objectives - identifies the customer's requirements for the level of confidence needed in a system's security features.

7.6.2.3 Notes

In cases where a specific claim is not mandated, it is helpful if the assurance objectives can be stated or related to a specific assurance claim to be achieved or met. This helps to reduce misunderstandings and ambiguity.

7.6.3 BP.06.02 - Define Assurance Strategy

Define a security assurance strategy to address all assurance objectives.

7.6.3.1 Description

The purpose of a security assurance strategy is to plan for and ensure that the security objectives are implemented and enforced correctly. Evidence produced through the implementation of a security assurance strategy should provide an acceptable level of confidence that the system security measures are adequate to manage the security risk. Effective management of the assurance related activities is achieved through the development and enactment of a security assurance strategy. Early identification and definition of assurance related requirements is essential to producing the necessary supporting evidence. Understanding and monitoring the satisfaction of customer assurance needs through continuous external coordination ensures a high quality assurance package.

7.6.3.2 Example Work Products:

- security assurance strategy - describes the plan for meeting the customer's security assurance objectives and identifies the responsible parties.

7.6.3.3 Notes

The security assurance strategy is coordinated with all affected internal engineering groups and external groups (e.g., customer, systems security certifier, or user) as defined in PA07.

7.6.4 BP.06.03 - Define Security Measures

Define measures to monitor security assurance objectives.

7.6.4.1 Description

Measures are used to facilitate decision making and improve performance and accountability through collection, analysis, and reporting of relevant performance-related data. The purpose of measuring performance is to monitor the status of security processes and facilitate improvement in those processes by applying corrective actions, based on observed measurements. Measures will facilitate monitoring of accomplishing assurance strategy and assurance objectives, and therefore, will support the assurance argument.

7.6.4.2 Example Work Products:

- listing of measurements aligned with assurance objectives and assurance strategy.

7.6.4.3 Notes

Measures need to be quantitative in nature, such as numbers and practical data. The measures need to be within reason of the cost of the project (i.e. the cost of collecting the data should not exceed the value of the data collected). Measures should be verifiable by third-party reviewers for concurrence of results. Some measures may be applicable for trend analysis and tell a story of impact changes overtime. The resulting measures should be useful in making decisions about focusing project efforts. They should be collected at the lowest level possible and not divisible into another format. Lastly, measures should be well-defined using such characteristics as frequency, formula, evidence, and indicators. For this BP, it is advisable to understand measurements required by external influences (i.e., government, industry, etc.)

7.6.5 BP.06.04 - Control Assurance Evidence

Identify and control security assurance evidence.

7.6.5.1 Description

Security assurance evidence is gathered as defined in the security assurance strategy through interaction with all security engineering process areas to identify evidence at various levels of abstraction. This evidence is controlled to ensure currency with existing work products and relevancy with security assurance objectives.

7.6.5.2 Example Work Products:

- security assurance evidence repository - stores all evidence generated during development, testing, and use. Could take the form of a database, engineering notebook, test results, or evidence log.

7.6.5.3 Notes

Assurance work products can be developed from the system, architecture, design, implementation, engineering process, physical development environment, and physical operational environment.

Security assurance evidence can be used to measure the efficiency, effectiveness, capacity, and impact of security. Identifying and controlling security assurance evidence will enable collection of higher quality data and more effective communication of the resulting analysis to a broader audience providing an objective mechanism to continually measure and improve the performance and results of the overall security processes.

7.6.6 BP.06.05 - Analyse Evidence

Perform analysis of security assurance evidence.

7.6.6.1 Description

Assurance evidence analysis is conducted to provide confidence that the evidence that is collected meets the security objectives, thus satisfying the customer's security needs. An analysis of the assurance evidence determines if system security engineering and security verification processes are adequate and complete enough to conclude that the security features and mechanisms are satisfactorily implemented. Additionally, the evidence is analysed to ensure that the engineering artifacts are complete and correct with respect to the baseline system. In the event of insufficient or inadequate assurance evidence, this analysis may necessitate revisions to the system, security work products and processes that support the security objectives.

7.6.6.2 Example Work Products:

- assurance evidence analysis results - identify and summarize the strengths and weaknesses of evidence in the repository.

7.6.6.3 Notes

Some assurance evidence can only be generated from a consolidation of other system engineering artifacts or inferred from a consolidation of other assurance.

7.6.7 BP.06.06 - Provide Assurance Argument

Provide a security assurance argument that demonstrates the customer's security needs are met.

7.6.7.1 Description

An overall assurance argument is developed to demonstrate compliance with security assurance objectives and provided to the customer. An assurance argument is a set of stated assurance objectives that are supported by a combination of assurance evidence that may be derived from multiple levels of abstraction. The assurance argument should be reviewed for deficiencies in the presentation of evidence as well as for deficiencies in meeting security assurance objectives.

7.6.7.2 Example Work Products:

- assurance argument with supporting evidence - a structured set of assurance objectives supported by various pieces of assurance evidence.

7.6.7.3 Notes

The high-level security assurance argument might be that objectives of the relevant criteria have been met. Other possible parts of the assurance argument might address how threats to system assets have been addressed. Each of the assurance objectives is supported by relevant and sufficient evidence to meet the applicable standard of proof. The assurance argument may be used by the customer, systems security certifier, and users.

7.7 PA07 - Coordinate Security

7.7.1 Process Area

7.7.1.1 Summary Description

The purpose of Coordinate Security is to ensure that all parties are aware of and involved with security engineering activities. This activity is critical as security engineering cannot succeed in isolation. This coordination involves maintaining open communications between all project personnel and external groups. Various mechanisms may be used to coordinate and communicate the security engineering decisions and recommendations between these parties, including memoranda, documents, e-mail, meetings, and working groups.

7.7.1.2 Goals:

- all members of the project team are aware of and involved with security engineering activities to the extent necessary to perform their functions; and
- decisions and recommendations related to security are communicated and coordinated.

7.7.1.3 Base Practice List

BP.07.01 Define security engineering coordination objectives and relationships.

BP.07.02 Identify coordination mechanisms for security engineering.

BP.07.03 Facilitate security engineering coordination.

BP.07.04 Use the identified mechanisms to coordinate decisions and recommendations related to security.

7.7.1.4 Process Area Notes

This process area ensures that security is an integral part of the total engineering effort. Security engineers should be part of all major design teams and working groups. It is especially important that security engineering establishes relationships with other engineering teams early in the life cycle when critical design decisions are made. This process area can be equally applied to both development and operational organizations.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.7.2 BP.07.01 - Define Coordination Objectives

Define security engineering coordination objectives and relationships.

7.7.2.1 Description

Many groups need to be aware of and involved with security engineering activities. The objectives for sharing information with these groups is determined by examining the project structure, information needs, and project requirements. Relationships and commitments with the other groups are established. Successful relationships take many forms, but must be acknowledged by all the involved parties.

7.7.2.2 Example Work Products:

- information sharing agreements - describe a process for sharing information between groups, identifying the parties involved, media, format, expectations, and frequency;
- working group memberships and schedules - describe the organization's working groups, including their membership, roles of members, purpose, agenda, and logistics; and
- organizational standards - describe the processes and procedures for communicating security related information between the various working groups and with the customer.

7.7.2.3 Notes

Coordination objectives and relationships should be defined as early as possible in the project to ensure that communication lines are well established. All engineering groups should define roles for security engineers in day to day operations (e.g., sit in on reviews, attend training, review designs). If this is not done, the risk of missing a key aspect of security increases.

7.7.3 BP.07.02 - Identify Coordination Mechanisms

Identify coordination mechanisms for security engineering.

7.7.3.1 Description

There are many ways that the security engineering decisions and recommendations can be shared with all engineering groups. This activity identifies the different ways that security is coordinated on a project.

It is not uncommon to have multiple security personnel working on the same project. In these situations, all security engineers should be working toward a commonly understood goal. Interface identification, security mechanism selection, training and development efforts need to be conducted in such a way as to ensure that each security component operates as expected when placed in the operational system. Additionally, all engineering teams must understand the security engineering efforts and engineering activities to allow for clean integration of security into the system. The customer must also be aware of events and activities related to security to ensure that requirements are identified and addressed appropriately.

7.7.3.2 Example Work Products:

- communication plans - include the information to be shared, meeting times, processes and procedures to be used between members of working groups and with other groups;
- communication infrastructure requirements - identify the infrastructure and standards needed to share information between working group members and with other groups effectively; and
- templates for meeting reports, message, memoranda - describe the format for various documents, to ensure standardization and efficient work.

7.7.3.3 Notes

None.

7.7.4 BP.07.03 - Facilitate Coordination

Facilitate security engineering coordination.

7.7.4.1 Description

Successful relationships rely on good facilitation. Communication between different groups with different priorities may result in conflicts. This base practice ensures that disputes are resolved in an appropriately productive manner.

7.7.4.2 Example Work Products:

- procedures for conflict resolution - identify the approach for efficiently resolving conflicts within and between organizational entities;
- meeting agendas, goals, action items - describes the topics to be discussed at a meeting, emphasizing the goals and action items to be addressed; and
- action item tracking - identifies the plan for working and resolving an action item, including responsibility, schedule, and priority.

7.7.4.3 Notes

None.

7.7.5 BP.07.04 - Coordinate Security Decisions and Recommendations

Use the identified mechanisms to coordinate decisions and recommendations related to security.

7.7.5.1 Description

The purpose of this base practice is to communicate security decisions and recommendations among the various security engineers, other engineering groups, external entities, and other appropriate parties.

7.7.5.2 Example Work Products:

- decisions - communication of security related decisions to affected groups via meeting reports, memoranda, working group minutes, e-mail, security guidance, or bulletin boards; and
- recommendations - communication of security related recommendations to affected groups such as via meeting reports, memoranda, working group minutes, e-mail, security guidance, or bulletin boards.

7.7.5.3 Notes

None.

7.8 PA08 - Monitor Security Posture

7.8.1 Process Area

7.8.1.1 Summary Description

The purpose of Monitor Security Posture is to ensure that all breaches of, attempted breaches of, or mistakes that could potentially lead to a breach of security are identified and reported. The external and internal environments are monitored for all factors that may have an impact on the security of the system.

7.8.1.2 Goals:

- both internal and external security related events are detected and tracked;
- incidents are responded to in accordance with policy; and
- changes to the operational security posture are identified and handled in accordance with the security objectives.

7.8.1.3 Base Practice List

BP.08.01 Analyse event records to determine the cause of an event, how it proceeded, and likely future events.

BP.08.02 Monitor changes in threats, vulnerabilities, impacts, risks, and the environment.

BP.08.03 Identify security relevant incidents.

BP.08.04 Monitor the performance and functional effectiveness of security safeguards.

BP.08.05 Review the security posture of the system to identify necessary changes.

BP.08.06 Manage the response to security relevant incidents.

BP.08.07 Ensure that the artifacts related to security monitoring are suitably protected.

7.8.1.4 Process Area Notes

The security posture indicates the readiness of the system and its environment to handle current threats, and vulnerabilities and any impact to the system and its assets. This process area then involves the activities in PA05 and PA03. The data gathered about both the internal and external environment is analysed both in its own context and in relation to other data that may result from events occurring before, in parallel with, or after an event in question. The process area addresses both the target environment intended for the system and the environment in which the system is developed. Any particular system has to function in conjunction with existing systems which can affect its overall security, thus these existing systems should be included in the monitoring.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.8.2 BP.08.01 - Analyse Event Records

Analyse event records to determine the cause of an event, how it proceeded, and likely future events.

7.8.2.1 Description

Examine historical and event records (compositions of log records) for security relevant information. The events of interest should be identified along with the factors used to correlate events among multiple records. Multiple event records can then be fused into a single event record.

7.8.2.2 Example Work Products:

- descriptions of each event - identify the source, impact, and importance of each detected event;
- constituent log records and sources - security related event records from various sources;
- event identification parameters - describe which events are and are not being collected by various parts of a system;
- listing of all current single log record alarm states - identifies all requests for action based on single log records;
- listing of all current single event alarm states - identifies all requests for action based on events which are formed from multiple log records;
- periodic report of all alarm states that have occurred - synthesizes alarm listings from multiple systems and does preliminary analysis; and
- log analysis and summaries - performs analysis on the alarms that have occurred recently and reports the results for broad consumption.

7.8.2.3 Notes

Many audit logs are likely to contain information related to a single event. This is particularly the case in a distributed/networked environment. Often an event leaves a trace in multiple locations across the network. To ensure that individual records are valuable and contribute to a complete understanding of the event and its behaviour, the individual log records need to be combined or fused into a single event record.

Analysis can be performed on single records and on multiple records. Analysis of multiple records of the same type often uses statistical or trend analysis techniques. Analysis of multiple records of different types may be performed on log records and event (fused) records, although it is more normal to perform multiple event record analysis on the same type of events.

Alarms, (i.e., requests for action based on a single occurrence), should be determined for both log records and fused event records. Log and event records from the development environment also need to be included in the analysis.

7.8.3 BP.08.02 - Monitor Changes

Monitor changes in threats, vulnerabilities, impacts, risks, and the environment.

7.8.3.1 Description

Look for any changes that may impact the effectiveness of the current security posture, either positively or negatively.

The security implemented for any system should be in relation to the threats, vulnerabilities, impacts and risks as they relate to its environment both internal and external. None of these are static and changes influence both the effectiveness and appropriateness of the system's security. All must be monitored for change and the changes analysed to assess their significance with regard to the effectiveness of the security.

7.8.3.2 Example Work Products:

- report of changes - identifies any external or internal changes that may affect the security posture of the system; and
- periodic assessment of significance of changes - performs analysis on changes in security posture to determine their impact and need for response.

7.8.3.3 Notes

Both internal and external sources should be examined as well as the development and operational environments.

When changes are noted a response should be triggered, usually a review of the risk analysis or part thereof. See PA03.

7.8.4 BP.08.03 - Identify Security Incidents

Identify security relevant incidents.

7.8.4.1 Description

Determine if a security relevant incident has occurred, identify the details, and make a report if necessary. Security relevant incidents may be detected using historical event data, system configuration data, integrity tools, and other system information. Since some incidents occur over a long period of time, this analysis is likely to involve comparison of system states over time.

7.8.4.2 Example Work Products:

- incident list and definitions - identifies common security incidents and describes them for easy recognition;
- incident response instructions - describes the appropriate response to security incidents that arise;
- incident reports - describes what incident occurred and all relevant details, including source of the incident, any damage, response taken, and further action required;
- reports related to each intrusion event detected - describes each intrusion event detected and provides all relevant details, including the source, any damage, response taken, and further action required; and

- periodic incident summaries - provides a summary of recent security incidents, noting trends, areas that may require more security, and possible cost savings from lowering security, keeping in mind the potential for increased risk.

7.8.4.3 Notes

Security incidents can occur in both the development and operational environment. These incidents can impact the system being developed or the operational system in different ways. Deliberate technical attacks by hackers or malicious code (viruses, worms, etc.) necessitate a different approach than protection against random events. Analysis of the system configuration and state is required to detect the attacks. Appropriate response plans should be prepared, tested and put into action. Many technical attacks require rapid, predefined response to minimize the ongoing spread of the damage. In many cases uncoordinated responses can make the situation worse. In the cases that necessitate it, the response should be identified and defined BP.08.06.

7.8.5 BP.08.04 - Monitor Security Safeguards

Monitor the performance and functional effectiveness of security safeguards.

7.8.5.1 Description

Examine the performance of safeguards to identify changes in the performance of the safeguard.

7.8.5.2 Example Work Products:

- periodic safeguard status - describes the state of the existing safeguards in order to detect possible misconfiguration or other problems; and

- periodic safeguard status summaries - provides a summary of the state of existing safeguards, noting trends, needed improvements, and possible cost savings from lowering security.

7.8.5.3 Notes

Safeguards protecting the development and operational environments should be monitored. Many safeguards can be left in an inappropriate or non-effective state after use. Many safeguards provide indications of their current status, effectiveness and maintenance requirements. All three aspects need to be reviewed on a periodic basis.

7.8.6 BP.08.05 - Review Security Posture

Review the security posture of the system to identify necessary changes.

7.8.6.1 Description

The security posture of a system is subject to change based on the threat environment, operational requirements, and system configuration. This practice re-examines the reasons why security was put in place and the requirements security places on other disciplines.

7.8.6.2 Example Work Products:

- security review - contains a description of the current security risk environment, the existing security posture, and an analysis of whether the two are compatible; and

- risk acceptance review - a statement by the appropriate approval authority that the risk associated with operating the system is acceptable.

7.8.6.3 Notes

A review of the security posture should be conducted in the light of the current operational environment and changes that have occurred. If other events, such as changes, have not triggered a complete review of security, a review should be triggered based on the time since the last review. Time triggered reviews should be in compliance with appropriate policy and regulations. The review should lead to a reassessment of the adequacy of current security and the appropriateness of the current level of risk acceptance. The review should be based on the organizations approach to security assessment, see PA05. In the same manner that the operational environment is reviewed, the development environment in which the systems is created should also be periodically reviewed. In fact, the development environment can be considered as an operational environment for the development of systems.

7.8.7 BP.08.06 - Manage Security Incident Response

Manage the response to security relevant incidents.

7.8.7.1 Description

In many cases, the continued availability of systems is critical. Many events can not be prevented, thus the ability to respond to disruption is essential. A contingency plan requires the identification of the maximum period of non-functionality of the system; the identification of the essential elements of the system for functionality; the identification and development of a recovery strategy and plan; testing of the plan; and the maintenance of the plan.

In some cases contingencies may include incident response and active engagement of hostile agents (e.g., viruses, hackers etc.).

7.8.7.2 Example Work Products:

- system recovery priority list - contains a description of the order in which system functions will be protected and restored in the case of an incident causing failure;
- test schedule - contains the dates for periodic testing of the system to ensure that security related functions and procedures are operational and familiar;
- test results - describe the results of periodic testing and what actions should be taken to keep the system secure;
- maintenance schedule - contains the dates for all system maintenance, both upgrades and preventative and is typically integrated with the test schedule;
- incident reports - describe what incident occurred and all relevant details, including source of the incident, any damage, response taken, and further action required;
- periodic reviews - describe the procedure to be performed during periodic reviews of the security of the system, including who is to be involved, what checks will be made, and what the output will contain; and
- contingency plans - identify the maximum acceptable period of system downtime, the essential elements of the system, a strategy and plan for system recovery, business resumption, situation management, and procedures for testing and maintenance of the plan.

7.8.7.3 Notes

Future events can not be pre-determined but, unless they are to cause chaos, they must be managed. If the situation falls outside the pre-identified scenarios, it is elevated to the appropriate business management decision level.

7.8.8 BP.08.07 - Protect Security Monitoring Artifacts

Ensure that the artifacts related to security monitoring are suitably protected.

7.8.8.1 Description

If the products of monitoring activities can not be depended upon they are of little value. This activity includes the sealing and archiving of related logs, audit reports and related analysis.

7.8.8.2 Example Work Products:

- a listing all archived logs and associated period of retention - identifies where artifacts associated with security monitoring are stored and when they can be disposed of;
- periodic results of spot checks of logs that should be present in archive - describe any missing reports and identifies the appropriate response;
- usage of archived logs - identifies the users of archived logs, including time of access, purpose, and any comments; and
- periodic results of testing the validity and usability of randomly selected archived logs - analyse randomly selected logs and determine whether they are complete, correct, and useful to ensure adequate monitoring of system security.

7.8.8.3 Notes

The majority of monitoring activities, including auditing, produce output. This output may be acted upon immediately or recorded for later analysis and further action. The contents of the logs should be designed to aid in the understanding of what occurred during an incident, and to detect changes in trends. The output log should be managed in compliance with applicable policy and regulations. Logs must be reliable and protected from tampering or accidental damage. When the log is full it must be replaced with a new one or emptied. When the log is changed any records that are not required should be removed and other reduction actions that may be required performed. Logs should be sealed, to prevent any changes from going undetected and should be archived for the proscribed period.

7.9 PA09 - Provide Security Input

7.9.1 Process Area

7.9.1.1 Summary Description

The purpose of Provide Security Input is to provide system architects, designers, implementers, or users with the security information they need. This information includes security architecture, design, or implementation alternatives and security guidance. The input is developed, analysed, provided to and coordinated with the appropriate organization members based on the security needs identified in PA01.

7.9.1.2 Goals:

- all system issues are reviewed for security implications and are resolved in accordance with security goals;
- all members of the project team have an understanding of security so they can perform their functions; and
- the solution reflects the security input provided.

7.9.1.3 Base Practice List

BP.09.01 Work with designers, developers, and users to ensure that appropriate parties have a common understanding of security input needs.

BP.09.02 Determine the security constraints and considerations needed to make informed engineering choices.

BP.09.03 Identify alternative solutions to security related engineering problems.

BP.09.04 Analyse and prioritize engineering alternatives using security constraints and considerations.

BP.09.05 Provide security related guidance to the other engineering groups.

BP.09.06 Provide security related guidance to operational system users and administrators.

7.9.1.4 Process Area Notes

This process area provides security input to support system design and implementation activities. The focus is on how security is an integral part of system development and not an end unto itself. Each of the base practices uses input from the entire engineering organization, produces security specific results, and communicates those results back to the entire engineering organization. The processes identified are applicable to the development of new systems or the operation and maintenance of existing ones.

This process area covers security input to both development (designers and implementors) and operation (users and administrators). In addition, by combining the design and implementation security activities into a single process area, it emphasizes that these activities are very similar, but are at different levels of abstraction. The alternative solutions range in scope from full system architectures to individual components. Some aspects of security requirements impact the environment in which the system is developed rather than the system itself.

All base practices within this process area can be iterative and all occur at multiple points through the system life cycle.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.9.2 BP.09.01 - Understand Security Input Needs

Work with designers, developers, and users to ensure that appropriate parties have a common understanding of security input needs.

7.9.2.1 Description

Security engineering is coordinated with other disciplines to determine the types of security input that are helpful to those disciplines. Security input includes any sort of guidance, designs, documents, or ideas related to security that should be considered by other disciplines. Input can take many forms, including documents, memoranda, e-mail, training, and consultation.

This input is based on the needs determined in PA10. For example, a set of security rules may need to be developed for the software engineers. Some of the inputs are more related to the environment than the system.

7.9.2.2 Example Work Products:

- agreements between security engineering and other disciplines - define how security engineering will provide input to other disciplines (e.g., documents, memoranda, training, consulting); and
- descriptions of input needed - standard definitions for each of the mechanisms for providing security input.

7.9.2.3 Notes

Assurance objectives may have an influence on the specific security needs, particularly in such aspects as dependencies. They may also provide additional justification to security needs. In this case, security engineering needs to provide the other disciplines with guidance on how to produce the appropriate evidence.

7.9.3 BP.09.02 - Determine Security Constraints and Considerations

Determine the security constraints and considerations needed to make informed engineering choices.

7.9.3.1 Description

The purpose of this base practice is to identify all the security constraints and considerations needed to make informed engineering choices. The security engineering group performs analysis to determine any security constraints and considerations on the requirements, design, implementation, configuration, and documentation. Constraints may be identified at all times during the system's life. They may be identified at many different levels of abstraction. Note that these constraints can be either positive (always do this) or negative (never do this).

7.9.3.2 Example Work Products:

- security design criteria - security constraints and considerations that are needed to make decisions regarding overall system or product design;
- security implementation rules - security constraints and considerations that apply to the implementation of a system or product (e.g., use of specific mechanisms, coding standards); and
- documentation requirements - identification of specific documentation needed to support security requirements (e.g., administrator's manual, user's manual, specific design documentation).

7.9.3.3 Notes

These constraints and considerations are used to identify security alternatives BP.09.03 and to provide security engineering guidance BP.09.05. A major source of the constraints and considerations is the security relevant requirements, identified in PA10.

7.9.4 BP.09.03 - Identify Security Alternatives

Identify solutions to security related engineering problems.

7.9.4.1 Description

The purpose of this base practice is to identify alternative solutions to security related engineering problems. This process is iterative and transforms security related requirements into implementations. These solutions can be provided in many forms, such as architectures, models, and prototypes. This base practice involves decomposing, analysing, and recomposing security related requirements until effective alternative solutions are identified.

7.9.4.2 Example Work Products:

- security views of system architecture - describe, at an abstract level, relationships between key elements of the system architecture in a way that satisfies the security requirements;
- security design documentation - includes details of assets and information flow in the system and a description of the functions of the system that will enforce security or that relate to security;

- security models - a formal presentation of the security policy enforced by the system; it must identify the set of rules and practices that regulate how a system manages, protects, and distributes information; the rules are sometimes expressed in precise mathematical terms [NCSC88];

- security architecture - focuses on the security aspects of a systems architecture, describing the principles, fundamental concepts, functions, and services as they relate to the security of the system; and

- reliance analysis (safeguard relationships and dependencies) - a description of how the security services and mechanisms interrelate and depend upon one another to produce effective security for the whole system; identifies areas where additional safeguards may be needed.

7.9.4.3 Notes

The solution alternatives include architecture, design, and implementation solutions. These security alternatives should be consistent with the constraints and considerations previously identified in BP.09.02. The alternatives are also a part of the trade-off comparisons BP.09.04. This activity is related to providing security engineering guidance BP.09.05 insomuch as once the preferred alternative has been selected, guidance to the other engineering disciplines is required.

7.9.5 BP.09.04 - Analyse Security of Engineering Alternatives

Analyse and prioritize engineering alternatives using security constraints and considerations.

7.9.5.1 Description

The purpose of this base practice is to analyse and prioritize engineering alternatives. Using the security constraints and considerations previously identified in BP.09.02, security engineers can evaluate each engineering alternative and come up with a recommendation for the engineering group. The security engineers should also consider the engineering guidance from other engineering groups.

These engineering alternatives are not limited to the security alternatives identified BP.09.03, but can include alternatives from other disciplines as well.

7.9.5.2 Example Work Products:

- trade-off study results and recommendations - includes analysis of all engineering alternatives considering security constraints and considerations as provided in BP09.02; and

- end-to-end trade-off study results - results of various decisions throughout the life cycle of a product, system, or process, focusing on areas where security requirements may have been reduced in order to meet other objectives (e.g., cost, functionality).

7.9.5.3 Notes

None.

7.9.6 BP.09.05 - Provide Security Engineering Guidance

Provide security related guidance to engineering groups.

7.9.6.1 Description

The purpose of this base practice is to develop security related guidance and provide it to the engineering groups. Security engineering guidance is used by the engineering groups to make decisions about architecture, design, and implementation choices.

7.9.6.2 Example Work Products:

- architecture recommendations - identify principles or constraints that will support the development of a system architecture that satisfies the security requirements;
- design recommendations - identify principles or constraints that guide the design of the system;
- implementation recommendations - identify principles or constraints that guide the implementation of the system;
- security architecture recommendations - identify principles or constraints that define the security features of the system;
- philosophy of protection - high-level description of how security is enforced, including automated, physical, personnel, and administrative mechanisms;
- design standards, philosophies, principles - constraints on how the system is designed (e.g., least privilege, isolation of security controls); and
- coding standards - constraints on how the system is implemented.

7.9.6.3 Notes

The amount of guidance required and the level of detail depends on the knowledge, experience and familiarity of the other engineering disciplines with security. In many cases much of the guidance may relate to the development environment rather than the system under development.

7.9.7 BP.09.06 - Provide Operational Security Guidance

Provide security related guidance to operational system users and administrators.

7.9.7.1 Description

The purpose of this base practice is to develop security related guidance and provide it to system users and administrators. This operational guidance tells the users and administrators what must be done to install, configure, operate, and decommission the system in a secure manner. To ensure that this is possible, the development of the operational security guidance should start early in the life cycle.

7.9.7.2 Example Work Products:

- administrator's manual - description of system administrator functions and privileges for installing, configuring, operating, and decommissioning the system in a secure manner;
- user's manual - description of the security mechanisms provided by the system and guidelines for their use;
- security profile - security environment (threats, organizational policy); security objectives (e.g., threats to be countered); security functional and assurance requirements; rationale that systems developed to these requirements will meet the objectives; and
- system configuration instructions - instructions for configuration of the system to ensure its operation will meet the security objectives.

7.9.7.3 Notes

The development environment is considered to be an operational environment for the development of systems.

7.10 PA10 - Specify Security Needs

7.10.1 Process Area

7.10.1.1 Summary Description

The purpose of Specify Security Needs is to explicitly identify the needs related to security for the system. Specify Security Needs involves defining the basis for security in the system in order to meet all legal, policy, and organizational requirements for security. These needs are tailored based upon the target operational security context of the system, the current security and systems environment of the organization, and a set of security objectives are identified. A set of security-related requirements is defined for the system that becomes the baseline for security within the system upon approval.

7.10.1.2 Goals:

- A common understanding of security needs is reached between all parties, including the customer.

7.10.1.3 Base Practice List

BP.10.01 Gain an understanding of the customer's security needs.

BP.10.02 Identify the laws, policies, standards, external influences and constraints that govern the system.

BP.10.03 Identify the purpose of the system in order to determine the security context.

BP.10.04 Capture a high-level security oriented view of the system operation.

BP.10.05 Capture high-level goals that define the security of the system.

BP.10.06 Define a consistent set of statements which define the protection to be implemented in the system.

BP.10.07 Obtain agreement that the specified security requirements match the customer's needs.

7.10.1.4 Process Area Notes

This process area covers the activities defining all aspects of security in the entire information system (e.g., physical, functional, procedural). The base practices address how the security needs are identified and refined into a coherent baseline of security-related requirements which are used in the design, development, verification, operation, and maintenance of the system. In most cases it is necessary to take into account the existing environment and associated security needs. The information gained and produced by this process area is collected, further refined, used, and updated throughout a project (particularly in PA09), in order to ensure customer needs are being addressed.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.10.2 BP.10.01 - Gain Understanding of Customer's Security Needs

Gain an understanding of the customer's security needs.

7.10.2.1 Description

The purpose of this base practice is to collect all information necessary for a comprehensive understanding of the customer's security needs. These needs are influenced by the importance to the customer of security risk. The target environment in which the system is intended to operate also influences the customer's needs with regard to security.

7.10.2.2 Example Work Products:

- customer security needs statement - high-level description of security required by the customer.

7.10.2.3 Notes

The term customer may refer to a specific recipient of a product, system, or service, or may refer to a generalized recipient based upon market research or product targeting. Different groups of customers may need to be identified and distinguished. For example, ordinary users may have different needs from administrators.

7.10.3 BP.10.02 - Identify Applicable Laws, Policies, And Constraints

Identify the laws, policies, standards, external influences and constraints that govern the system.

7.10.3.1 Description

The purpose of this base practice is to gather all external influences which affect the security of the system. A determination of applicability should identify the laws, regulations, policies and commercial standards which govern the target environment of the system. A determination of precedence between global and local policies should be performed. Requirements for security placed on the system by the system customer must be identified and the security implications extracted.

7.10.3.2 Example Work Products:

- security constraints - laws, policies, regulations, and other constraints that influence the security of a system; and

- security profile - security environment (threats, organizational policy); security objectives (e.g., threats to be countered); security functional and assurance requirements; rationale that systems developed to these requirements will meet the objectives.

7.10.3.3 Notes

Particular consideration is required when the system will cross multiple physical domains. Conflict may occur between laws and regulations that are applicable in different countries and different types of business. As part of the identification process, conflicts should at a minimum, be identified and resolved if possible.

7.10.4 BP.10.03 - Identify System Security Context

Identify the purpose of the system in order to determine the security context.

7.10.4.1 Description

The purpose of this base practice is to identify how the system's context impacts security. This involves understanding the purpose of the system (e.g., intelligence, financial, medical). Mission processing and operations scenarios are assessed for security considerations. A high-level understanding of the threat to which the system is or may be subject to is required at this stage. Performance and functional requirements are assessed for possible impacts on security. Operating constraints are also reviewed for their security implications.

The environment might also include interfaces with other organizations or systems in order to define the security perimeter of the system. Interface elements are determined to be either inside or outside of the security perimeter.

Many factors external to the organization also influence, to varying degrees, the security needs of the organization. These factors include the political orientation and changes in political focus, technology developments, economic influences, global events, and Information Warfare activities. As none of these factors are static, they require monitoring and periodic assessment of the potential impact of change.

7.10.4.2 Example Work Products:

- expected threat environment - any known or presumed threats to the system assets against which protection is needed; include threat agent (expertise, available resources, motivation), the attack (method, vulnerabilities exploited, opportunity), the asset; and

- target of evaluation - description of the system or product whose security features are to be evaluated (type, intended application, general features, limitations of use) [CCEB96].

7.10.4.3 Notes

The security perimeter of the system is not necessarily identical to the system boundary (e.g., the security perimeter could contain the facility in which the system resides and the personnel operating the system whereas the system boundary may stop at the human-machine interface). This expanded security perimeter enables physical measures to be considered as effective safeguards for access control in addition to purely technical measures.

7.10.5 BP.10.04 - Capture Security View of System Operation

Capture a high-level security oriented view of the system operation.

7.10.5.1 Description

The purpose of the base practice is to develop a high-level security oriented view of the enterprise, including roles, responsibilities, information flow, assets, resources, personnel protection, and physical protection. This description should include a discussion of how the enterprise can be managed within the constraints of the system requirements. This view of the system is typically provided in a security concept of operations and should include a high-level security view of the system architecture, procedures, and the environment. Requirements related to the system development environment are also captured at this stage.

7.10.5.2 Example Work Products:

- security concept of operations - high-level security oriented view of the system (roles, responsibilities, assets, information flow, procedures); and

- conceptual security architecture - a conceptual view of the security architecture; see BP.09.03.

7.10.5.3 Notes

None.

7.10.6 BP.10.05 - Capture High-Level Security Goals

Capture high-level goals that define the security of the system.

7.10.6.1 Description

The purpose of this base practice is to identify what security objectives should be met to provide adequate security for the system in its operational environment. The assurance objectives of the system, determined in PA06 may influence the security objectives.

7.10.6.2 Example Work Products:

- operational/environmental security policy - rules, directives, and practices that govern how assets are managed, protected, and distributed within and external to an organization; and

- system security policy - rules, directives, and practices that govern how assets are managed, protected, and distributed by a system or product.

7.10.6.3 Notes

The security objectives should be, as far as possible, independent of any particular implementation. If particular constraints are present due to the existing environment they should be addressed in PA09 when security constraints and considerations for making informed engineering choices are determined. The security objectives should as a minimum address the availability, accountability, authenticity, confidentiality, integrity and reliability requirements of the system and information.

7.10.7 BP.10.06 - Define Security Related Requirements

Define a consistent set of requirements which define the protection to be implemented in the system.

7.10.7.1 Description

The purpose of this base practice is to define the security-related requirements of the system. The practice should ensure each requirement is consistent with the applicable policy, laws, standards, requirements for security and constraints on the system. These requirements should completely define the security needs of the system including those requirements to be provided through non-technical means. It is normally necessary to define or specify the boundary of the target, logical or physical, to ensure that all aspects are addressed. The requirements should be mapped or related to the objectives of the system. The security-related requirements should be clearly and concisely stated and should not contradict one another. Security should, whenever possible, minimize any impact on the system functionality and performance. The security-related requirements should provide a basis for evaluating the security of the system in its target environment.

7.10.7.2 Example Work Products:

- security related requirements - requirements which have a direct effect on the secure operation of a system or enforce conformance to a specified security policy; and

- traceability matrix - mapping of security needs to requirements to solutions (e.g., architecture, design, implementation) to tests and test results.

7.10.7.3 Notes

Many requirements apply to multiple disciplines, so few requirements are exclusively security. This process area, therefore, requires a great deal of coordination with other disciplines to work out exactly what the system requirements are. The activities associated with this interaction are described in PA07.

7.10.8 BP.10.07 - Obtain Agreement On Security

Obtain agreement that the specified security requirements match the customer's needs.

7.10.8.1 Description

The purpose of this base practice is to obtain concurrence between all applicable parties on the security requirements. In cases where a generic group is identified, rather than a specific customer, the requirements should satisfy the objectives set. The specified security requirements should be a complete and consistent reflection of governing policy, laws, and customer needs. Issues should be identified and reworked until concurrence is gained.

7.10.8.2 Example Work Products:

- approved security objectives - stated intent to counter identified threats and/or comply with identified security policies (as approved by the customer); and

- security related requirements baseline - the minimum set of security related requirements as agreed to by all applicable parties (specifically the customer) at specified milestones.

7.10.8.3 Notes

It is important to ensure that what is agreed is truly understood by all concerned and that all have the same understanding. Particular care is required to ensure that the security requirements mean the same thing to all those involved in the process.

7.11 PA11 - Verify and Validate Security

7.11.1 Process Area

7.11.1.1 Summary Description

The purpose of Verify and Validate Security is to ensure that solutions are verified and validated with respect to security. Solutions are verified against the security requirements, architecture, and design using observation, demonstration, analysis, and testing. Solutions are validated against the customer's operational security needs.

7.11.1.2 Goals:

- solutions meet security requirements; and

- solutions meet the customer's operational security needs.

7.11.1.3 Base Practice List

BP.11.01 Identify the solution to be verified and validated.

BP.11.02 Define the approach and level of rigour for verifying and validating each solution.

BP.11.03 Verify that the solution implements the requirements associated with the higher level of abstraction.

BP.11.04 Validate the solution by showing that it satisfies the needs associated with the previous level of abstraction, ultimately meeting the customer's operational security needs.

BP.11.05 Capture the verification and validation results for the other engineering groups.

7.11.1.4 Process Area Notes

This process area is an important part of system verification and validation and occurs at all levels of abstraction. Security architectures and designs are normally arranged hierarchically each succeeding level providing more detail about the design that the previous one. Solutions include everything from operational concepts to architectures to implementations and span the entire information system, including environment and procedures.

In the interest of obtaining objective results, the verification and validation group should be a group that is different than the engineering groups; however, the group may be working side-by-side with the engineering groups. The results of both verification and validation may be fed back to the entire engineering groups at any time during the solution life cycle. Verification and validation are sometimes associated with the concepts of correctness and effectiveness.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

7.11.2 BP.11.01 - Identify Verification and Validation Targets

Identify the solution to be verified and validated.

7.11.2.1 Description

The purpose of this base practice is to identify the targets of the verification and validation activities. Verification demonstrates that the solution is correctly implemented, while validation demonstrates that the solution is effective. This involves coordination with all the engineering groups throughout the life cycle.

7.11.2.2 Example Work Products:

- verification and validation plans - definition of the verification and validation effort (includes resources, schedule, work products to be verified and validated).

7.11.2.3 Notes

Many work products can be verified and validated, spanning a wide range of abstraction and complexity. These include requirements, designs, architectures, implementations, hardware items, software items, and test plans. Work products associated with operation and maintenance of a system can also be verified and validated, including system configuration, user documentation, training materials, and incident response plans.

7.11.3 BP.11.02 - Define Verification and Validation Approach

Define the approach and level of rigour for verifying and validating each solution.

7.11.3.1 Description

The purpose of this base practice is to define the approach and level of rigour for verifying and validating each solution. Identifying the approach involves selecting how each requirement is verified and validated. The level of rigour should indicate how intense the scrutiny of the verification and validation effort should be and is influenced by the output of the assurance strategy from PA06. For example, some projects may require a cursory inspection for compliance with the requirements and others may require much more rigorous examination.

The methodology should also include a means to maintain traceability from the customer's operational security needs to security requirements to solutions to validation and verification results.

7.11.3.2 Example Work Products:

- test, analysis, demonstration, and observation plans - definition of the verification and validation methods to be used (e.g., testing, analysis) and the level of rigour (e.g., informal or formal methods);
- test procedures - definition of the steps to be taken in the testing of each solution; and
- traceability approach - description of how verification and validation results will be traced to the customer's security needs and requirements.

7.11.3.3 Notes

The security verification and validation approach should be compatible with the overall system verification and validation approach. This will require significant coordination and interaction. Activities related to coordination are described in PA07.

7.11.4 BP.11.03 - Perform Verification

Verify that the solution implements the requirements associated with the higher level of abstraction.

7.11.4.1 Description

The purpose of this base practice is to verify that the solution is correct by showing that it implements the requirements associated with the higher level of abstraction including the assurance requirements identified as a result of PA06. There are many methods of verifying requirements, including testing, analysis, observation, and demonstration. The method to be used is identified in BP.11.02. Both the individual requirements and the overall system are examined.

7.11.4.2 Example Work Products:

- raw data from test, analysis, demonstration, and observation - results from any approaches used in verifying that the solution meets the requirements; and
- problem reports - inconsistencies discovered in verifying that a solution meets the requirements.

7.11.4.3 Notes

None.

7.11.5 BP.11.04 - Perform Validation

Validate the solution by showing that it satisfies the needs associated with the higher level of abstraction, ultimately meeting the customer's operational security needs.

7.11.5.1 Description

The purpose of this base practice is to validate that the solution satisfies the needs associated with the higher level of abstraction. Validation demonstrates that the solution meets these needs effectively. There are many ways to validate that these needs have been met, including testing the solution in an operational or representative test setting. The method to be used is identified in BP.11.02.

7.11.5.2 Example Work Products:

- problem reports - inconsistencies discovered in validating that a solution meets the security need;
- inconsistencies - areas where the solution does not meet the security needs; and
- ineffective solutions - solutions that do not meet the customer's security needs.

7.11.5.3 Notes

This practice is related to traceability.

7.11.6 BP.11.05 - Provide Verification and Validation Results

Capture the verification and validation results for engineering groups.

7.11.6.1 Description

The purpose of this base practice is to capture and provide the verification and validation results. The verification and validation results should be provided in a way that is easy to understand and use. The results should be tracked so that the traceability from needs, to requirements, to solution, and to test results is not lost.

7.11.6.2 Example Work Products:

- test results - documentation of outcome of testing; and
- traceability matrix - mapping of security needs to requirements to solutions (e.g., architecture, design, implementation) to tests and test results.

7.11.6.3 Notes

None.

Annex A
(normative)

Generic Practices

Generic Practices are specified in ISO/IEC 15504-2. The original contents of this Annex have been moved to a new Annex D, which is informative. It is retained for backwards compatibility purposes.

Annex B
(normative)

Project and Organizational Base Practices

B.1 General

The SSE-CMM® includes the Project and Organization process areas adapted from the SE-CMM®. These process areas are an important part of the SSE-CMM® and for interpreting the generic practices.

Each process area includes a “security considerations” section that indicates some considerations for applying the process area in the context of security engineering. This section also references related SSE-CMM® process areas.

B.2 General Security Considerations

In addition to the specific considerations on the interpretation sheet for each process area, the following sections include general considerations with respect to security engineering for all of the Project and Organization process areas.

B.2.1 Project Risk vs. Security Risk

The Project and Organization process areas use the term “risk.” In these cases, the reference to “Project Risk” is risk related to the successful completion of a project, addressing issues related to cost and schedule. The systems security engineering process areas address “Security Risk” activities as determining whether operational impacts due to residual security risks are tolerable. Results of security risk assessments may provide input to, and influence project risk management activities, though project and Organization process areas do not address management of security risks referenced in the Engineering process areas.

B.2.2 Applicability to Operational Phase

Although the wording of the Project and Organization process areas seems to imply applicability to only development aspects, the process areas apply equally to the operation and maintenance phase of a life cycle. The process areas will need to be interpreted for assessment or improvement purposes based on the view of the process areas that are applicable to an organization. The few exceptions are noted in the security considerations area.

B.2.3 Security Engineering vs. Systems Engineering

The term “Systems Engineering” is used throughout the Project and Organization process areas (for example, “Improve Organization's Systems Engineering Processes”). The use of these process areas, however, is broadly applicable. The term “Systems Engineering” should be substituted with the term “Security Engineering” when the process areas are applied in the context of security engineering. Process areas also need to address the security engineering perspective by ensuring the integration of security engineering with other engineering disciplines.

B.2.4 Engineering Relationships

Systems engineering and security engineering relationships are indicated for each process area. Note there are many relationships between the various process areas (in these sections only the major relationships are identified).

B.3 PA12 - Ensure Quality

B.3.1 Process Area

B.3.1.1 Security Considerations

PA06 is related to ensure quality. Assurance can be considered a specific type of security related quality.

B.3.1.2 Summary Description

The purpose of Ensure Quality is to address not only the quality of the system, but also the quality of the process being used to create the system and the degree to which the project follows the defined process. The underlying concept of this process area is that high-quality systems can only be consistently produced if a process exists to continuously measure and improve quality. In addition, this process must be adhered to throughout the system life cycle. Key aspects of the process required to develop high-quality systems are measurement, analysis, and corrective action.

B.3.1.3 Goals:

- process quality is defined and measured; and
- expected work product quality achieved.

B.3.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.12.01 Identify quality requirements for each work product.

BP.12.02 Ensure the defined system engineering process is adhered to during the system life cycle.

BP.12.03 Evaluate work product measures against the requirements for work product quality.

BP.12.04 Measure the quality of the systems engineering process used by the project.

BP.12.05 Analyse quality measurements to develop recommendations for quality improvement or corrective action as appropriate.

BP.12.06 Obtain employee participation in identifying and reporting quality issues.

BP.12.07 Initiate activities that address identified quality issues or quality improvement opportunities.

BP.12.08 Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products.

B.3.1.5 Process Area Notes

A successful quality program requires integration of the quality efforts throughout the project team and support elements. Effective processes provide a mechanism for building in quality and reduce dependence on end-item inspections and rework cycles.

This is not meant to imply that those managing and/or assuring the quality of work products and processes are solely responsible for the quality of the work product outputs. On the contrary, the primary responsibility for “building in” quality lies with the builders. A quality management process helps to ensure that all aspects of quality management are seriously considered and acted upon by the organization and reflected in its products. This increases the confidence of developers, management, and customers in the system's quality.

The kinds of quality variances that may be addressed by this process area include technical content, such as the particular values of derived or allocated requirements; and form issues (e.g., such as whether the customer prefers instructions on product use to be in paper or electronic form). Higher than planned costs and delays in the schedule can also be considered defects and would be dealt with as are other defects.

Organizations may wish to determine the variances, from expected values, of technical and other issues in increments that correspond to the schedule commitments of the organization (e.g., if the organization has committed to deliver or roll-out a product during a given week, then it would be wise to measure or determine its progress, by measuring variances, on a weekly basis).

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of Process Area 12 Ensure Quality are addressed in the Project Control Process of ISO/IEC 15288.

B.3.2 BP.12.01 - Identify the requirements for work product quality

Identify quality requirements for each work product.

B.3.2.1 Description

Different types of work products and different specific work products may have different quality requirements. These quality requirements should be identified when the work product is defined.

B.3.2.2 Example Work Products:

- work product quality requirements; and
- generic work product quality requirements lists.

B.3.2.3 Notes

None.

B.3.3 BP.12.02 - Monitor Conformance to the Defined Process

Ensure the defined system engineering process is adhered to during the system life cycle.

B.3.3.1 Description

Ensure that the project's execution follows the defined system engineering process. Compliance should be checked at regular intervals. Deviations from the defined process and the impact of the deviation should be assessed and recorded.

B.3.3.2 Example Work Products:

- recorded deviations from defined systems engineering process;
- recorded impact of deviations from defined systems engineering process; and
- quality handbook (paper or on-line).

B.3.3.3 Notes

The defined process can be monitored in a number of ways (e.g., a designated auditor/reviewer can participate in or observe all (or a sample percentage of) process activities, or an auditor/reviewer may inspect all (or a sample percentage of) in-process work products).

B.3.4 BP.12.03 - Measure Quality of the Work Product

Evaluate work product measures against the requirements for work product quality.

B.3.4.1 Description

Measuring the characteristics of the work product, related to conformance with requirements and standards, correctness and timeliness, provides an indication of the quality of the system. Measurements should be designed to assess whether the work product will meet customer and engineering requirements. Product measurements should also be designed to help isolate problems with the system development process.

B.3.4.2 Example Work Products:

- assessment of the quality of the product; and
- product quality certification.

B.3.4.3 Notes

Example approaches to measurement of work product quality include:

- statistical process control of product measurements at various points in the development process; and
- measurement of a complete set of process results against requirements such as:
    - specification value,
    - planned value,
    - tolerance band,
    - demonstrated value,
    - demonstrated technical variance,
    - current estimate, and
    - predicted technical variance.

B.3.5 BP.12.04 - Measure Quality of the Process

Measure the quality of the systems engineering process used by the project.

B.3.5.1 Description

The process that is used to create a quality product is as important as the quality of the product. It is important to have a system development process that is checked by measurement so that degrading conditions are identified early, before the final work product is produced and found to not meet requirements. Thus, having a process that is measured may lead to less waste and higher productivity.

B.3.5.2 Example Work Products:

- process quality certification.

B.3.5.3 Notes

Examples of tools to use in measuring the process include:

- process flow chart: can be used to determine which characteristics should be measured and to identify potential sources of variation, in addition to defining the process;
- statistical process control on process parameters; and
- design of experiments.

B.3.6 BP.12.05 - Analyse Quality Measurements

Analyse quality using the measurements to develop recommendations for quality improvement or corrective action, as appropriate.

B.3.6.1 Description

Careful examination of all of the available data on product, process, and project performance can reveal causes of problems. This information will then enable improvement of the process and product quality.

B.3.6.2 Example Work Products:

- analysis of deviations;
- failure analysis;
- defect reports;
- system quality trends;
- corrective action recommendations; and
- cause and effect diagrams.

B.3.6.3 Notes

Examples of measurements that support quality improvement include:

- trend analysis, such as the identification of equipment calibration issues causing a slow creep in the product parameters; and
- standards evaluation, such as determining if specific standards are still applicable due to technology or process changes.

B.3.7 BP.12.06 - Obtain Participation

Obtain employee participation in identifying and reporting quality issues.

B.3.7.1 Description

The development of a quality work product, using a quality process that is adhered to, requires the focus and attention of all of the people involved. Ideas for improving quality need to be encouraged, and a forum needs to exist that allows each employee to raise process quality issues freely.

B.3.7.2 Example Work Products:

- environment that promotes quality; and
- captured inputs and resolutions from workers.

B.3.7.3 Notes

A quality environment can be fostered by:

- process action teams;
- a quality assurance group with a reporting chain of command that is independent of the project; and
- an independent channel for reporting quality issues.

B.3.8 BP.12.07 - Initiate Quality Improvement Activities

Initiate activities that address identified quality issues or quality improvement opportunities.

B.3.8.1 Description

In order to continuously improve quality, specific actions must be planned and executed. Specific aspects of the system development process that jeopardize product or process quality need to be identified and corrected. This would include minimizing cumbersome or bureaucratic systems.

B.3.8.2 Example Work Products:

- recommendations for improving the systems engineering process;
- quality improvement plan; and
- process revisions.

B.3.8.3 Notes

Effective implementation of quality improvement activities requires input and buy-in by the work product team.

B.3.9 BP.12.08 - Detect Need for Corrective Actions

Establish a mechanism or a set of mechanisms to detect the need for corrective actions to processes or products.

B.3.9.1 Description

Such a mechanism must be available throughout the life cycle of the product (development through manufacturing through customer use). Mechanisms may include online reporting systems, workshops, periodic reviews, customer focus groups, etc. Mechanisms must be available to all affected groups, including design, manufacturing, customers, customer support, etc.

B.3.9.2 Example Work Products:

- ongoing database or repository containing identified needs, process improvements, and product improvements;
- clearly described processes, methods, and avenues for getting identified needs into a database or repository;
- identified needs for process improvement;
- identified needs for product improvement; and
- trouble reports.

B.3.9.3 Notes

This base practice is critical to the effective use of systems engineering in the production, operations, and maintenance life-cycle phases.

Needs for corrective action are detected in this base practice. Corrective actions are directed in PA15.

Trouble reports also flow into this base practice from PA11.

B.4 PA13 - Manage Configurations

B.4.1 Process Area

B.4.1.1 Security Considerations

In BP.13.02 the determination of the level of configuration units identified for a system/project should consider the level of detail required by the assurance objectives in PA06.

Manage Configurations provides evidence to PA06. Also, the configuration management system selected should itself be managed according to PA01.

B.4.1.2 Summary Description

The purpose of Manage Configurations is to maintain data on and the status of identified configuration units, and to analyse and control changes to the system and its configuration units. Managing the system configuration involves providing accurate and current configuration data and status to developers and customers.

This process area is applicable to all work products that are placed under configuration management. An example set of work products that may be placed under configuration management could include hardware and software configuration items, design rationale, requirements, product data files, or trade studies.

B.4.1.3 Goals:

- Control over work product configurations is maintained.

B.4.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.13.01 Decide on an appropriate method for configuration management.

BP.13.02 Identify the indivisible units for configuration management.

BP.13.03 Maintain a repository of work product baselines.

BP.13.04 Control changes to established configuration units.

BP.13.05 Communicate status of configuration data, proposed changes, and access information to affected groups.

B.4.1.5 Process Area Notes

The configuration management function supports traceability by allowing the configuration to be traced back through the hierarchy of system requirements at any point in the configuration life cycle. Traceability is established as part of the practices in PA10.

When the practices of this process area are used to manage requirements, changes to those requirements need to be iterated through PA10 to communicate the impact of changes to the customer or their surrogate.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA 13 addressed in the Configuration Management Process of ISO/IEC 15288.

B.4.2 BP.13.01 - Establish Configuration Management Method

Decide on an appropriate method for configuration management.

B.4.2.1 Description

Three primary trade-off considerations will have an impact on the structure and cost of configuration management, including:

- the level of detail at which the configuration units are identified;
- when the configuration units are placed under configuration management; and
- the level of formalization required for the configuration management process.

B.4.2.2 Example Work Products:

- guidelines for identifying configuration units;
- timeline for placing configuration units under configuration management;
- selected configuration management process; and
- selected configuration management process description.

B.4.2.3 Notes

Example criteria for selecting configuration units at the appropriate work product level include:

- need to maintain interfaces at a manageable level;
- unique user requirements such as field replaceable units;
- new versus modified design; and
- expected rate of change.

These criteria will affect the level of visibility into the design effort.

Example criteria for determining when to place work products under configuration management include:

- portion of the development life cycle that the project is in;
- if system element is ready for test;
- degree of formalization selected;
- cost and schedule limitations; and
- customer requirements.

Example criteria for selecting a configuration management process include:

- portion of the development life cycle;
- impact of change in system on other work products;
- impact of change in system on procured or subcontracted work products;
- impact of change in system on program schedule and funding; and
- requirements management.

B.4.3 BP.13.02 - Identify Configuration Units

Identify the indivisible units for configuration management.

B.4.3.1 Description

A configuration unit is one or more work products that are treated as an indivisible unit for configuration management. The selection of work products for configuration management should be based on criteria established in the selected configuration management strategy. Configuration units should be selected at a level that benefits the developers and customers, but that does not place an unreasonable administrative burden on the developers.

B.4.3.2 Example Work Products:

- work product configuration; and
- identified configuration units.

B.4.3.3 Notes

Configuration units in the area of requirements management could vary from individual requirements to groupings of requirements.

Configuration units for a system that has requirements on field replacement should have an identified configuration unit at the field-replaceable unit level.

B.4.4 BP.13.03 - Maintain Work Product Baselines

Maintain a repository of work product baselines.

B.4.4.1 Description

This practice involves establishing and maintaining a repository of information about the work product configuration. Typically, this consists of capturing data or describing the configuration units. This could also include an established procedure for additions, deletions, and modifications to the baseline, as well as procedures for tracking/monitoring, auditing, and the accounting of configuration data. Another objective of maintaining the configuration data is to provide an audit trail back to source documents at any point in the system life cycle.

B.4.4.2 Example Work Products:

- decision database;
- configuration baseline; and
- traceability matrix.

B.4.4.3 Notes

In the case of hardware configuration units, the configuration data would consist of specifications, drawings, trade study data, etc. Optimally, configuration data can be maintained in electronic format to facilitate updates and changes to supporting documentation.

Software configuration units typically include source code files, requirements and design data, and test plans and results.

B.4.5 BP.13.04 - Control Changes

Control changes to established configuration units.

B.4.5.1 Description

Control is maintained over the work product configuration baseline. This includes tracking the configuration of each of the configuration units, approving a new configuration, if necessary, and updating the baseline.

Identified problems with the work product or requests to change the work product are analysed to determine the impact that the change will have on the work product, program schedule and cost, and other work products. If, based upon analysis, the proposed change to the work product is accepted, a schedule is identified for incorporating the change into the work product and other affected areas.

Changed configuration units are released after review and formal approval of configuration changes. Changes are not official until they are released.

B.4.5.2 Example Work Products:

- new work-product baselines.

B.4.5.3 Notes

Change control mechanisms can be tailored to categories of changes (e.g., the approval process should be shorter for component changes that do not affect other components).

B.4.6 BP.13.05 - Communicate Configuration Status

Communicate status of configuration data, proposed changes, and access information to affected groups.

B.4.6.1 Description

Inform affected groups of the status of configuration data whenever there are any status changes. The status reports should include information on when accepted changes to configuration units will be processed, and the associated work products that are affected by the change. Access to configuration data and status should be provided to developers, customers, and other affected groups.

B.4.6.2 Example Work Products:

- status reports.

B.4.6.3 Notes

Examples of activities for communicating configuration status include:

- provide access permissions to authorized users; and
- make baseline copies readily available to authorized users.

B.5 PA14 - Manage Project Risks

B.5.1 Process Area

B.5.1.1 Security Considerations

Manage Project Risks refers to risk related to the successful completion of the project, addressing issues related to cost and schedule. The Engineering process areas address “Security Risk” activities, by determining whether operational impacts due to residual security risks are tolerable. Results of security risk activities may provide input to and influence project risk management activities.

PA07 should be taken into account to ensure that security issues are addressed.

B.5.1.2 Summary Description

The purpose of Manage Project Risks is to identify, assess, monitor, and mitigate risks to the success of both the systems engineering activities and the overall technical effort. This process area continues throughout the life of the project. Similar to PA16 and PA15 process areas, the scope of this process area includes both the systems engineering activities and the overall technical project effort, as the systems engineering effort on the project cannot be considered successful unless the overall technical effort is successful.

B.5.1.3 Goals:

- risks to the program are identified, understood, and mitigated.

B.5.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.14.01 Develop a plan for risk management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project.

BP.14.02 Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong.

BP.14.03 Assess risks and determine the probability of occurrence and consequence of realization.

BP.14.04 Obtain formal recognition of the project risk assessment.

BP.14.05 Implement the risk mitigation activities.

BP.14.06 Monitor risk mitigation activities to ensure that the desired results are being obtained.

B.5.1.5 Process Area Notes

All system development efforts have inherent risks, some of which are not easily recognized. Especially early on, the likelihood of known risks and the existence of unknown risks should be sought out. Poor risk management is often cited as a primary reason for unsatisfied customers, and cost or schedule overruns. Early detection and reduction of risks avoids the increased costs of reducing risks at a more advanced state of system development.

It is important to note the distinction among risk types, analysis, and management approach. Good risk management operates on all three dimensions (e.g., analysing developer risk primarily deals with the management approach, i.e., profit and market building; whereas analysing user risk primarily is concerned with types and analysis, i.e., mission and goal satisfaction).

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA14 are addressed in the Risk Management Process of ISO/IEC 15288. It is important to understand that neither PA14 nor the Risk Management Process of ISO/IEC 15288 deal with Security Risk, but are exclusively focused on the risks that arise to the performance of the project.

B.5.2 BP.14.01 - Develop Risk Management Approach

Develop a plan for risk management activities that is the basis for identifying, assessing, mitigating, and monitoring risks for the life of the project.

B.5.2.1 Description

The purpose of this base practice is to develop an effective plan to guide the risk management activities of the project. Elements of the plan should include identification of members of the risk management team and their responsibilities; a schedule of regular risk management activities, methods, and tools to be employed in risk identification and mitigation; and methods of tracking and controlling risk mitigation activities. The plan should also provide for the assessment of risk management results.

B.5.2.2 Example Work Products:

- risk management plan.

B.5.2.3 Notes

Examples of risk management approaches include:

- use a spiral management approach where the objectives for the next cycle and the objectives for the overall project are clarified and documented periodically;
- formally identify and review risks at the beginning of each cycle and develop mitigation approaches; and
- at the end of each cycle, review progress made in reducing each risk.

B.5.3 BP.14.02 - Identify Risks

Identify project risks by examining project objectives with respect to the alternatives and constraints, and identifying what can go wrong.

B.5.3.1 Description

Examine the project objectives, the project plans (including activity or event dependencies), and the system requirements in an orderly way to identify probable areas of difficulties and what can go wrong in these areas. Sources of risk based on past experience should be considered to identify potential risks. This activity is enacted during PA16. Establishing critical development dependencies and providing tracking and corrective action is performed in PA15.

B.5.3.2 Example Work Products

- list of identified risks.

B.5.3.3 Notes

Examples of activities to identify risks include:

- develop a common risk classification scheme or risk taxonomy to categorize risks. This taxonomy contains the history of risks for each category, including probabilities of occurrence (which system elements contribute most to risk), estimated cost of occurrence, and mitigation strategies. This practice is very useful in improving risk estimates and in reusing successful risk-mitigation [Charette 89].;

- focus mitigation resources and controls on system elements which contribute most to risk;

- collect all the information specifying project and systems engineering objectives, alternative technical strategies, constraints, and success criteria. Ensure that the objectives for the project and the systems engineering effort are clearly defined. For each alternative approach suggested to meet the objectives, document items that may prevent attainment of the objectives: these items are risks. Following this procedure results in a list of risks per alternative approach. Note that some risks will be common across all the alternatives; and

- interview technical and management personnel to uncover assumptions and decisions leading to risk. Use historical data from similar projects to find out where problems have arisen in similar contexts.

B.5.4 BP.14.03 - Assess Risks

Assess risks and determine the probability of occurrence and consequence of realization.

B.5.4.1 Description

Estimate the chance of potential loss (or gain) and the consequence if the previously identified risks occur. Analyse the risks independently of one another and understand the relationships between different individual risks. The analysis methodology should take into account factors such as the probability of failure due to the maturity and complexity of the technology.

B.5.4.2 Example Work Products:

- risk assessment.

B.5.4.3 Notes

Examples of activities to assess risks include:

- develop standards for estimating the probability and cost of risk occurrence. Possible standards range from a simple high-moderate-low qualitative scale to quantitative scales in dollars and probability to the nearest tenth of a percent; and

- establish a practical standard based on the project's size, duration, overall risk exposure, system domain, and customer environment [Charette 89].

B.5.5 BP.14.04 - Review Risk Assessment

Obtain formal recognition of the project risk assessment.

B.5.5.1 Description

Review adequacy of the risk assessment and obtain a decision to proceed, modify, or cancel the effort based on risks. This review should include the potential risk mitigation efforts and their probability of success.

B.5.5.2 Example Work Products:

- risk mitigation strategy.

B.5.5.3 Notes

Examples of activities to review the risk assessment include:

- hold a meeting of all stakeholders of the project internal to the company to present the risk assessment. To help communicate a sense of control over the risks, present possible mitigation strategies along with each risk; and

- obtain agreement from the attendees that the risk estimates are reasonable and that no obvious mitigation strategies are being overlooked.

B.5.6 BP.14.05 - Execute Risk Mitigation

Implement the risk mitigation activities.

B.5.6.1 Description

Risk mitigation activities may address lowering the probability that the risk will occur or lowering the extent of the damage the risk causes when it does occur. For risks that are of particular concern, several risk mitigation activities may be initiated at the same time.

B.5.6.2 Example Work Products:

- risk mitigation plan.

B.5.6.3 Notes

Examples of activities to mitigate risks include the following:

- to address the risk that the delivered system will not meet a specific performance requirement, build a prototype of the system or a model that can be tested against this requirement. This type of mitigation strategy lowers the probability of risk occurrence;

- to address the risk that the delivery schedule will slip due to a subsystem not being available for integration, develop alternative integration plans with different integration times for the risky subsystem. If the risk occurs (i.e., the subsystem is not ready on time), the impact of the risk on the overall schedule will be less. This type of mitigation strategy lowers the consequence of risk occurrence; and

- use predetermined baselines (risk referents) to trigger risk-mitigation actions [Charette 89].

B.5.7 BP.14.06 - Track Risk Mitigation

Monitor risk mitigation activities to ensure that the desired results are being obtained.

B.5.7.1 Description

On a regular basis, examine the results of the risk mitigation that have been put into effect, to measure the results, and determine whether the mitigation have been successful.

B.5.7.2 Example Work Products:

- risk status; and

- risk taxonomy.

B.5.7.3 Notes

For a project with a development schedule of about six months, re-assess risks every two weeks. Re-estimate the probability and consequence of each risk occurrence.

B.6 PA15 - Monitor and Control Technical Effort

B.6.1 Process Area

B.6.1.1 Security Considerations

PA08 and PA01 need to be taken into account both during the development effort and during the operation of the system.

PA07 should be taken into account to ensure that security issues are addressed.

B.6.1.2 Summary Description

The purpose of Monitor and Control Technical Effort is to provide adequate visibility of actual progress and risks. Visibility encourages timely corrective action when performance deviates significantly from plans.

Monitor and Control Technical Effort involves directing, tracking and reviewing the project's accomplishments, results, and risks against its documented estimates, commitments, and plans. A documented plan is used as the basis for tracking the activities and risks, communicating status, and revising plans.

B.6.1.3 Goals:

- the technical effort is monitored and controlled.

B.6.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.15.01 Direct technical effort in accordance with technical management plans.

BP.15.02 Track actual use of resources against technical management plans.

BP.15.03 Track performance against the established technical parameters.

BP.15.04 Review performance against the technical management plans.

BP.15.05 Analyse issues resulting from the tracking and review of technical parameters to determine corrective actions.

BP.15.06 Take corrective actions when actual results deviate from plans.

B.6.1.5 Process Area Notes

Similar to PA16, this process area applies to the project's technical activities as well as to the systems engineering effort.

Progress is primarily determined by comparing the actual effort, work product sizes, cost, and schedule to the plan when selected work products are completed and at selected milestones. When it is determined that the plans are not being met, corrective actions are taken. These actions may include revising the plans to reflect the actual accomplishments and replanning the remaining work, or taking actions to improve performance or reduce risks.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA15 are addressed in two processes of ISO/IEC 15288, namely Project Assessment Process and Project Control Process.

B.6.2 BP.15.01 - Direct Technical Effort

Direct technical effort in accordance with technical management plans.

B.6.2.1 Description

Carry out the technical management plans created in the Plan Technical Effort process area. This practice involves technical direction of all of the engineering activities of the project.

B.6.2.2 Example Work Products:

- matrix of responsibilities;
- work authorizations.

B.6.2.3 Notes

Effective technical direction includes the use of appropriate communication mechanisms and timely distribution of technical information to all affected parties. All technical direction must be captured to preserve the basis for decisions and actions.

B.6.3 BP.15.02 - Track Project Resources

Track actual use of resources against technical management plans.

B.6.3.1 Description

Provide current information on the use of resources during the project to help adjust the effort and plans when needed.

B.6.3.2 Example Work Products:

- resource usage.

B.6.3.3 Notes

Tracking cost includes comparing the actual costs to the estimates documented in the project plan to identify potential overruns and underruns.

B.6.4 BP.15.03 - Track Technical Parameters

Track performance against the established technical parameters.

B.6.4.1 Description

The actual performance of the project and its products is tracked by measuring the technical parameters established in the technical management plan. These measurements are compared to the thresholds established in the technical management plan so that warnings of problems can be communicated to management.

B.6.4.2 Example Work Products:

- profile of technical performance management.

B.6.4.3 Notes

Example Practice: For each technical parameter, define a bench marking activity that will be used to obtain the measurement. Use persons from outside the control of the project manager to perform the bench marking activities to ensure objective measurements. Periodically perform the bench marking activity and compare the actual measurement with the planned values of the parameters.

B.6.5 BP.15.04 - Review Project Performance

Review performance against the technical management plans.

B.6.5.1 Description

The performance of the project and its products is reviewed periodically and when technical parameter thresholds are exceeded. The results of analysing the measurements of technical performance are reviewed, along with other indicators of technical performance, and corrective action plans are approved.

B.6.5.2 Example Work Products:

- change requests for the technical management plan; and
- approved corrective actions.

B.6.5.3 Notes

Examples of reviewing performance include:

- holding a meeting of all stakeholders of the project internal to the organization to present analyses of performance and suggested corrective actions; and
- writing a status report which forms the basis of a project review meeting.

B.6.6 BP.15.05 - Analyse Project Issues

Analyse issues resulting from the tracking and review of technical parameters to determine corrective actions.

B.6.6.1 Description

New project issues surface frequently and continuously through the project life cycle. Timely identification, analysis, and tracking of issues is crucial to controlling project performance.

B.6.6.2 Example Work Products:

- analysis of project performance issues; and
- approved corrective actions.

B.6.6.3 Notes

New information is integrated with historical project data. Trends that are hurting the project are identified, along with new issues that indicate risks to the project's success. Obtain more detailed data, as needed, for issues and trends that are inconclusive. Analysis frequently requires modelling and simulation tools as well as outside expert opinions.

B.6.7 BP.15.06 - Take Corrective Action

Take corrective actions when technical parameters indicate future problems or when actual results deviate from plans.

B.6.7.1 Description

When corrective actions are approved, take the corrective actions by reallocating resources, changing methods and procedures, or increasing adherence to the existing plans. When changes to the technical management plan are necessary, employ the practices of PA16 to revise the plan.

B.6.7.2 Example Work Products:

- resource reallocation;
- changes to methods and procedures; and
- change orders.

B.6.7.3 Notes

This base practice covers whatever actions are needed to prevent anticipated problems or to correct the problems discovered. The possible actions taken under this base practice are varied and numerous.

B.7 PA16 - Plan Technical Effort

B.7.1 Process Area

B.7.1.1 Security Considerations

PA07 should be taken into account, particularly during the performance of BP.16.05 for the entire life cycle of the project, and BP.16.06 to support effective interaction with the customers and suppliers.

B.7.1.2 Summary Description

The purpose of Plan Technical Effort is to establish plans that provide the basis for scheduling, costing, controlling, tracking, and negotiating the nature and scope of the technical work involved in system development, manufacturing, use, and disposal. System engineering activities must be integrated into comprehensive technical planning for the entire project.

Plan Technical Effort involves developing estimates for the work to be performed, obtaining necessary commitments from interfacing groups, and defining the plan to perform the work.

B.7.1.3 Goals:

- all aspects of the technical effort are planned.

B.7.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.16.01 Identify resources that are critical to the technical success of the project.

BP.16.02 Develop estimates for the factors that affect the magnitude and technical feasibility of the project.

BP.16.03 Develop cost estimates for all technical resources required by the project.

BP.16.04 Determine the technical process to be used on the project.

BP.16.05 Identify technical activities for the entire life cycle of the project.

BP.16.06 Define specific processes to support effective interaction with the customer(s) and supplier(s).

BP.16.07 Develop technical schedules for the entire project life cycle.

BP.16.08 Establish technical parameters with thresholds for the project and the system.

BP.16.09 Use the information gathered in planning activities to develop technical management plans that will serve as the basis for tracking the salient aspects of the project and the systems engineering effort.

BP.16.10 Review the technical management plans with all affected groups and individuals, and obtain group commitment.

B.7.1.5 Process Area Notes

Planning begins with an understanding of the scope of the work to be performed, along with the constraints, risks, and goals that define and bound the project. The planning process includes steps to estimate the size of work products, estimate the resources needed, produce a schedule, consider risks, and negotiate commitments. Iterating through these steps may be necessary to establish a plan that balances quality, cost, and schedule goals.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA16 are addressed in the Project Planning Process of ISO/IEC 15288.

B.7.2 BP.16.01 - Identify Critical Resources

Identify resources that are critical to the technical success of the project.

B.7.2.1 Description

Critical resources are resources that are essential to the success of the project and that may not be available for the project. Critical resources may include personnel with special skills, tools, facilities, or data. Critical resources can be identified by analysing project tasks and schedules, and by comparing this project with similar projects.

B.7.2.2 Example Work Products:

- identified critical resources.

B.7.2.3 Notes

Example practice: Examine the project schedules and think of the types of resources required at each point in time. List resources that are not easily obtainable. Cross check and augment this list by thinking of engineering skills that are required to synthesize the system and work products.

B.7.3 BP.16.02 - Estimate Project Scope

Develop estimates for the factors that affect the magnitude and technical feasibility of the project.

B.7.3.1 Description

The project's scope and size can be estimated by decomposing the system into component elements that are similar to those of other projects. The size estimate can then be adjusted for factors such as differences in complexity or other parameters.

Historical sources often provide the best available information to use for initial size estimates. These estimates will be refined as more information on the current system becomes available.

B.7.3.2 Example Work Products:

- estimates of the scope of the system;
- number of source lines of code;
- number of cards of electronics;
- number of large forgings; and
- number of cubic yards of material to be moved.

B.7.3.3 Notes

Example practice: Analyse the available project documentation, and interview project personnel to determine the main technical constraints and assumptions. Identify the possible highest level technical approaches and the factors that may keep the project or the systems engineering effort from being successful. Identify the major technical parameters and estimate the acceptable range for each parameter.

B.7.4 BP.16.03 - Estimate Project Costs

Develop cost estimates for all technical resources required by the project.

B.7.4.1 Description

A detailed estimate of project costs is essential to good project management, whether or not a customer requires it. Estimates of project costs are made by determining the labour costs, material costs, and subcontractor costs based on the schedule and the identified scope of the effort. Both direct costs and indirect costs (such as the cost of tools, training, special test and support items) are included. For labour costs, historical parameters or cost models are employed to convert hours to dollars based on job complexity, tools, available skills and experience, schedules, and direct and overhead rates. Appropriate reserves are established, based on identified risks.

B.7.4.2 Example Work Products:

- total labour cost by skill level and schedule;
- cost of material by item, vendor, and schedule;
- cost of subcontracts by vendor and schedule;
- cost of tools;
- cost of training; and
- supporting rationale.

B.7.4.3 Notes

A considerable amount of project data such as scope, schedule, and material items must be collected prior to estimating costs. Checklists and historical data from other projects can be used to identify cost items that may otherwise be overlooked. Variance reports and “lessons-learned” documents are typically good sources of this type of information.

B.7.5 BP.16.04 - Determine Project's Process

Determine the technical process to be used on the project.

B.7.5.1 Description

At the highest level, the technical process should follow a life-cycle model based on the characteristics of the project, the characteristics of the organization, and the organization's standard process. Typical life-cycle models include waterfall, evolutionary spiral, and incremental. In the process definition, include process activities, inputs, outputs, sequences, and quality measures for process and work products.

B.7.5.2 Example Work Products:

- selected systems engineering process for the project.

B.7.5.3 Notes

Establish and maintain an integrated management plan that defines the project's interaction with all internal and external organizations (e.g., the subcontractor) performing the technical effort. Include the planned project life-cycle model for the project and specific project activities.

B.7.6 BP.16.05 - Identify Technical Activities

Identify technical activities for the entire life cycle of the project.

B.7.6.1 Description

Project and systems engineering activities may be selected from applicable standards, known best practice within the industry segment, reference models such as the SSE-CMM®, or the organization's historical experience.

B.7.6.2 Example Work Products:

- identified technical activities.

B.7.6.3 Notes

Use historical records from similar projects, where possible, to develop the list of activities and to gain confidence that the list is complete. Use the “rolling wave” paradigm for planning. The “rolling wave” paradigm is used to define near-term activities more precisely than activities that start later in the project.

Example Practice: The systems engineering activities would be decomposed into activities planned for the next three months until each activity is approximately two weeks in duration. Activities 3 to 12 months away should be planned at approximately a month in duration. Activities starting more than a year away can be described at a very high level, approximately two months in duration. For the non systems engineering technical activities, use this same method while working with other disciplines according to the process area PA09.

B.7.7 BP.16.06 - Define Project Interface

Define specific processes to support effective interaction with customer(s) and supplier(s).

B.7.7.1 Description

Project interfaces include all those with organizations and individuals who are necessary to successful project execution, whether they are inside or outside the project group. Types of interaction include information exchange, tasking, and deliveries. Methods and processes (including controls) for interaction are established as appropriate for the parties that are interacting.

B.7.7.2 Example Work Products:

- defined processes for project interfaces.

B.7.7.3 Notes

For the project, identify the groups internal and external to your organization that the project needs to interact with in order to be successful. For each group, perform the base practices of PA09 to define and implement each interface in terms of interaction mechanisms, interaction frequency, and problem resolution mechanisms.

B.7.8 BP.16.07 - Develop Project Schedules

Develop technical schedules for the entire project life cycle.

B.7.8.1 Description

Project schedules include system and component development, obtaining procured items, training, and preparing the engineering support environment. Schedules are based on verifiable effort models or data for identified tasks, and they must allow for task interdependencies and the availability of procured items. Schedules should also include slack time appropriate for identified risks. All affected parties must review and commit to the schedule.

B.7.8.2 Example Work Products:

- project schedules.

B.7.8.3 Notes

Schedules typically include both customer and technical milestones.

Example Practice: Within project constraints (contractual, market timing, customer-provided inputs, etc.), define system increments consistent with the overall technical approach. Each increment should provide more system capability from the user's point of view. Estimate the additional staff hours required to develop each increment.

To create a schedule that uses resources at a level rate, select dates for completion of each increment proportional to the amount of work required to develop the increment. Derive detailed schedules for technical activities within each increment by sequencing the activities from the start of the increment and taking into account dependencies between activities.

For an event-driven schedule, the loading is typically not level. For non critical path activities, it may be necessary to adjust the activity duration, activity sequencing, or activity start dates to avoid unacceptable resource peaking.

B.7.9 BP.16.08 - Establish Technical Parameters

Establish technical parameters with thresholds for the project and the system.

B.7.9.1 Description

Establish key technical parameters that can be traced over the life of the project and that will serve as in-progress indicators for meeting the ultimate technical objectives. Key technical parameters can be identified through interaction with the customer, customer requirements, market research, prototypes, identified risks, or historical experience on similar projects. Each technical parameter to be tracked should have a threshold or tolerance beyond which some corrective action would be expected. Key technical parameters should have pre-planned assessments scheduled at useful points in the project schedule.

B.7.9.2 Example Work Products:

- technical parameters; and
- technical parameter thresholds.

Examples of technical parameters include:

- payload capacity of cargo aircraft;
- sensor resolution;

- portable stereo weight;
- automobile gas mileage; and
- video monitor distortion.

B.7.9.3 Notes

Example Practice: Identify aspects of the system that are primary drivers of system performance. Develop a metric for each aspect that can be tracked over time while the system is being developed.

B.7.10 BP.16.09 - Develop Technical Management Plan

Use the information gathered in planning activities to develop technical management plans that will serve as the basis for tracking the salient aspects of the project and the systems engineering effort.

B.7.10.1 Description

Establish and maintain an integrated management plan that defines project interaction with all internal and external organizations (e.g., the subcontractor) performing the technical effort.

B.7.10.2 Example Work Products:

- technical management plan.

B.7.10.3 Notes

Technical management plans typically include:

- plans for developing the system; and
- plans for interacting with other organizations (e.g., subcontractors) performing the technical effort.

B.7.11 BP.16.10 - Review and Approve Project Plans

Review the technical management plans with all affected groups and individuals, and obtain group commitment.

B.7.11.1 Description

The objective of project plan reviews is to ensure a bottom-up, common understanding of the process, resources, schedule, and information requirements by affected groups and individuals throughout the project. Inputs on the project plan are solicited from all responsible organizational elements and project staff. Whenever possible, these inputs are incorporated to build team ownership of the plans. If an input is rejected or modified, feedback is provided to the individual who gave the input. Interim and completed project plans are distributed for review. A commitment to the project plans should be obtained from all groups comprising the project team.

B.7.11.2 Example Work Products:

- interface issues between disciplines/groups;
- risks;
- project plan inputs;

- project plan comments; and
- project plan issues and resolutions.

B.7.11.3 Notes

Affected groups and individuals typically include:

- software engineering;
- hardware engineering;
- manufacturing;
- management;
- customers;
- users;
- partners; and
- subcontractors.

Example Practice: Identify questions that each group should answer as part of their review (the questions may be different for different groups.) Communicate to the groups how the review will be conducted. Provide the technical management plans to the groups and, at the pre-arranged time, meet with them to discuss their comments. Produce a list of issues from the reviewers' comments and work on each issue until it is resolved.

B.8 PA17 - Define Organization's Systems Engineering Process

B.8.1 Process Area

B.8.1.1 Security Considerations

This process area uses the term “Systems Engineering”. However, this process area is broadly applicable and the term “Systems Engineering” can be replaced with the term “Security Engineering” when assessing an organization's security engineering capability.

Base practices need to address the integration of security engineering with systems engineering and other engineering disciplines. Therefore, PA07 should be taken into account when defining the organization's security engineering process.

B.8.1.2 Summary Description

The purpose of Define Organization's Systems Engineering Process is to create and manage the organization's standard systems engineering processes, which can subsequently be tailored by a project to form the unique processes that it will follow in developing its systems or products.

Define Organization's Systems Engineering Process involves defining, collecting, and maintaining the process that will meet the business goals of the organization, as well as designing, developing, and documenting systems engineering process assets. Assets include example processes, process fragments, process-related documentation, process architectures, process-tailoring rules and tools, and process measurements.

B.8.1.3 Goals:

- A standard systems engineering process is defined for the organization.

B.8.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.17.01 Establish goals for the organization's systems engineering process from the organization's business goals.

BP.17.02 Collect and maintain systems engineering process assets.

BP.17.03 Develop a well-defined standard systems engineering process for the organization.

BP.17.04 Define guidelines for tailoring the organization's standard systems engineering process for project use in developing the project's defined process.

B.8.1.5 Process Area Notes

This process area covers the initial activities required to collect and maintain process assets, including the organization's standard systems engineering process. The improvement of the process assets and the organization's standard systems engineering process are covered in PA18.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of Process Area 17 Define Organization's Systems Engineering Process are addressed in two Processes of ISO/IEC 15288, namely System LifeCycle Management (part thereof) and some of the activities of the Resources Management Process.

B.8.2 BP.17.01 - Establish Process Goals

Establish goals for the organization's systems engineering process from the organization's business goals.

B.8.2.1 Description

The systems engineering process operates in a business context, and this must be explicitly recognized in order to institutionalize the organization's standard practice. The process goals should consider the financial, quality, human resource, and marketing issues important to the success of the business.

B.8.2.2 Example Work Products:

- goals of the organization's systems engineering process;
- requirements for the organization's standard systems engineering process;
- requirements for the organization's process asset library; and
- process asset library.

B.8.2.3 Notes

Establishing goals may include determining the tradeoff criteria for process performance based on time-to-market, quality, and productivity business issues.

B.8.3 BP.17.02 - Collect Process Assets

Collect and maintain systems engineering process assets.

B.8.3.1 Description

The information generated by the process definition activity, both at the organization and project levels, needs to be stored (e.g., in a process asset library), made accessible to those who are involved in tailoring and process design efforts, and maintained so as to remain current.

B.8.3.2 Example Work Products:

- instructions for use of a process asset library;
- design specifications for a process asset library; and
- process assets.

B.8.3.3 Notes

The purpose of a process asset library is to store and make available process assets that projects will find useful in defining the process for developing the system. It should contain examples of processes that have been defined, and the measurements of the process. When the organization's standard systems engineering process has been defined, it should be added to the process asset library, along with guidelines for projects to tailor the organization's standard systems engineering process when defining the project's process.

Process assets typically include:

- the organization's standard systems engineering process;
- the approved or recommended development life cycles;
- project processes together with measurements collected during the execution of the processes;
- guidelines and criteria for tailoring the organization's standard systems engineering process;
- process-related reference documentation; and
- measurements of the project's process.

B.8.4 BP.17.03 - Develop Organization's Systems Engineering Process

Develop a well-defined standard systems engineering process for the organization.

B.8.4.1 Description

The organization's standard systems engineering process is developed using the facilities of the process asset library. New process assets may be necessary during the development task and should be added to the process asset library. The organization's standard systems engineering process should be placed in the process asset library.

B.8.4.2 Example Work Products:

- organization's standard systems engineering process;
- inputs to training; and
- inputs to systems engineering process improvement.

B.8.4.3 Notes

The standard systems engineering process should include the interfaces to the organization's other defined processes. In addition, references used to define the systems engineering process (e.g., military standards, IEEE standards) should be cited and maintained.

To develop the standard systems engineering process, an organization can identify all the process elements or activities of the organization's system engineering process. The organization must evaluate the process elements for consistency of inputs and outputs, redundant activities, and missing activities. Inconsistencies must be resolved between process elements and provision made for appropriate sequencing and verification features. The resulting process should be well defined.

A well-defined process includes:

- readiness criteria;
- inputs;
- standards and procedures; and
- verification mechanisms:
    - peer reviews,
    - outputs, and
    - completion criteria [SPICE94].

B.8.5 BP.17.04 - Define Tailoring Guidelines

Define guidelines for tailoring the organization's standard systems engineering process for project use in developing the project's defined process.

B.8.5.1 Description

Since the organization's standard systems engineering process may not be suitable for every project's situation, guidelines for tailoring it are needed. The guidelines should be designed to fit a variety of situations, while not allowing projects to bypass standards or substantial and important practices prescribed by organization policy that must be followed.

B.8.5.2 Example Work Products:

- tailoring guidelines for the organization's standard systems engineering process.

B.8.5.3 Notes

Guidelines should enable the organization's standard systems engineering process to be tailored to address contextual variables such as the domain of the project; the cost, schedule, and quality tradeoffs; the experience of the project's staff; the nature of the customer; the technical difficulty of the project, etc.

B.9 PA18 - Improve Organization's Systems Engineering Processes

B.9.1 Process Area

B.9.1.1 Security Considerations

In Improve Organization's Systems Engineering Processes, the term “Systems Engineering” is used. This process area however, is broadly applicable and the term Systems Engineering is substituted with the term “Security Engineering” when assessing an organization's security engineering capability. In addition, base practices need to address the integration of security engineering with systems engineering disciplines.

B.9.1.2 Summary Description

The purpose of Improve Organization's Systems Engineering Processes is to gain competitive advantage by continuously improving the effectiveness and efficiency of the systems engineering processes used by the organization. It involves developing an understanding of the organization's processes in the context of the organization's business goals, analysing the performance of the processes, and explicitly planning and deploying improvements to those processes.

B.9.1.3 Goals:

- Improvements to the standard systems engineering process are planned and implemented.

B.9.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.18.01 Appraise the existing processes being performed in the organization to understand their strengths and weaknesses.

BP.18.02 Plan improvements to the organization's processes based on analysing the impact of potential improvements on achieving the goals of the processes.

BP.18.03 Change the organization's standard systems engineering process to reflect targeted improvements.

BP.18.04 Communicate process improvements to existing projects and to other affected groups, as appropriate.

B.9.1.5 Process Area Notes

This process area covers the continuing activities to measure and improve the performance of systems engineering processes in the organization. The initial collection of the organization's process assets and the definition of the organization's standard system engineering process is covered in PA17.

Guidance on improving the standard process may be obtained from several sources, including lessons learned, application of the generic practices, and appraisals of the standard process against the SE-CMM®. The resulting profile of capability levels against process areas will point to the most needed areas for improvement. Incorporating the generic practices in these process areas will be useful.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA18 are addressed in the remaining activities of System LifeCycle Management Process of ISO/IEC 15288.

B.9.2 BP.18.01 - Appraise the Process

Appraise the existing processes being performed in the organization to understand their strengths and weaknesses.

B.9.2.1 Description

Appraise the existing processes being performed in the organization to understand their strengths and weaknesses.

B.9.2.2 Example Work Products:

- process maturity profiles;
- process performance analyses;
- appraisal findings; and
- gap analyses.

B.9.2.3 Notes

An example appraisal scenario: Appraise the organization's current systems engineering processes using the SE-CMM® and its associated appraisal method. Use the results of the appraisal to establish or update process performance goals.

If delays and queues occur in the execution of the existing systems engineering process, then an organization may focus on them as starting points for cycle-time reduction. Recheck such process features as readiness criteria, inputs, and verification mechanisms.

B.9.3 BP.18.02 - Plan Process Improvements

Plan improvements to the organization's processes based on analysing the impact of potential improvements on achieving the goals of the processes.

B.9.3.1 Description

Appraising the process provides momentum for change. This momentum must be harnessed by planning improvements that will provide the most payback for the organization in relation to its business goals. The improvement plans provide a framework for taking advantage of the momentum gained in appraisal. The planning should include targets for improvement that will lead to high-payoff improvements in the process.

Organizations may take this opportunity to “mistake-proof” the process and eliminate wasted effort. It is important to make the process stable (i.e., performed consistently by everyone). Deployment is commonly a challenge. In making improvements, be careful to avoid optimizing locally, and thereby creating problems in other areas.

B.9.3.2 Example Work Products:

- process improvement plan.

B.9.3.3 Notes

Perform tradeoffs on proposed process improvements against estimated returns in cycle time, productivity, and quality. Use the techniques of PA09.

B.9.4 BP.18.03 - Change the Standard Process

Change the organization's standard systems engineering process to reflect targeted improvements.

B.9.4.1 Description

Improvements to the organization's standard systems engineering process, along with necessary changes to the tailoring guidelines in the process asset library, will preserve the improved process and encourage projects to incorporate the improvements for new products.

B.9.4.2 Example Work Products:

- organization's standard systems engineering process; and
- tailoring guidelines for the organization's standard systems engineering process.

B.9.4.3 Notes

As improvements to the standard systems engineering process are implemented and evaluated, the organization should adopt the successful improvements as permanent changes to the standard systems engineering process.

B.9.5 BP.18.04 - Communicate Process Improvements

Communicate process improvements to existing projects and to other affected groups, as appropriate.

B.9.5.1 Description

Some process improvements may be useful to existing projects, and they can incorporate the useful improvements into their current project's process depending upon the status of the project. Others who are responsible for training, quality assurance, measurement, etc., should be informed of the process improvements.

B.9.5.2 Example Work Products:

- instructions for use of the process asset library;
- tailoring guidelines for the organization's standard systems engineering process;
- enumeration and rationale for changes made to the systems engineering process; and
- schedule for incorporating the process changes.

B.9.5.3 Notes

Process improvements, as well as the rationale and expected benefits of the changes, should be communicated to all affected projects and groups. The organization should develop a deployment plan for the updated processes and monitor conformance to that deployment plan.

B.10 PA19 - Manage Product Line Evolution

B.10.1 Process Area

B.10.1.1 Security Considerations

Product lines consisting of security products have special requirements which include: stringent configuration management practices; personnel clearance requirements for the development of secure code; and obtaining certification and accreditation of secure products. All of these requirements add to the length of the product development cycle and life cycle costs.

PA06 is also relevant in order to ensure that new or modified products continue to meet the customer's security needs.

B.10.1.2 Summary Description

The purpose of Manage Product Line Evolution is to introduce services, equipment, and new technology to achieve the optimal benefits in product evolution, cost, schedule, and performance over time as the product line evolves toward its ultimate objectives.

An organization must first determine the evolution of a product. Then the organization has to decide how it will design and build those products including critical components, cost-effective tools, and efficient and effective processes.

B.10.1.3 Goals:

- Product lines are evolved towards their ultimate objectives.

B.10.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.19.01 Define the types of products to be offered.

BP.19.02 Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.

BP.19.03 Make the necessary changes in the product development cycle to support the development of new products.

BP.19.04 Ensure critical components are available to support planned product evolution.

BP.19.05 Insert new technology into product development, marketing, and manufacturing.

B.10.1.5 Process Area Notes

The Manage Product Line Evolution process area is needed "…to ensure that product development efforts converge to achieve strategic business purposes, and to create and improve the capabilities needed to make research and product development a competitive advantage over the long term." [Wheelwright 92].

This process area covers the practices associated with managing a product line, but not the engineering of the products themselves.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA19 are addressed in two Processes of ISO/IEC 15288, namely some of the activities of Environment Management and Operation.

B.10.2 BP.19.01 - Define Product Evolution

Define the types of products to be offered.

B.10.2.1 Description

Define the product lines that support the organization's strategic vision.

Consider the organization's strengths and weaknesses, the competition, potential market size, and available technologies.

B.10.2.2 Example Work Products:

- product line definition.

B.10.2.3 Notes

Defined product lines enable a more effective reuse approach and allow investments with high potential payoff.

B.10.3 BP.19.02 - Identify New Product Technologies

Identify new product technologies or enabling infrastructure that will help the organization acquire, develop, and apply technology for competitive advantage.

B.10.3.1 Description

Identify new product technologies for potential introduction into the product line. Establish and maintain sources and methods for identifying new technology and infrastructure improvements, such as facilities or maintenance services.

B.10.3.2 Example Work Products:

- reviews of product-line technology; and
- improvements recommended by process teams.

B.10.3.3 Notes

This practice involves identifying, selecting, evaluating, and pilot testing new technologies. By maintaining an awareness of technology innovations and systematically evaluating and experimenting with them, the organization selects appropriate technologies to improve the quality of its product lines and the productivity of its engineering and manufacturing activities. Pilot efforts are performed to assess new and unproven technologies before they are incorporated into the product line. Infrastructure improvements such as facilities upgrades or enhancements to the service of the distribution chain may also provide opportunities for evolving a product line toward its future objectives.

B.10.4 BP.19.03 - Adapt Development Processes

Make the necessary changes in the product development cycle to support the development of new products.

B.10.4.1 Description

Adapt the organization's product development processes to take advantage of components intended for future use.

B.10.4.2 Example Work Products:

- adapted development processes.

B.10.4.3 Notes

This practice can include establishing a library of reusable components, which includes the mechanisms for identifying and retrieving components.

B.10.5 BP.19.04 - Ensure Critical Component Availability

Ensure critical components are available to support planned product evolution.

B.10.5.1 Description

The organization must determine the critical components of the product line and plan for their availability.

B.10.5.2 Example Work Products:

- product-line components.

B.10.5.3 Notes

The availability of critical components can be ensured by incorporating considerations for the future use of these components into the product line requirements. Appropriate resources must be allocated by the organization to maintain the components on a continuous basis.

B.10.6 BP.19.05 - Insert Product Technology

Insert new technology into product development, marketing, and manufacturing.

B.10.6.1 Description

Manage the introduction of new technology into the product lines, including both modifications of existing product-line components and the introduction of new components. Identify and manage risks associated with product design changes.

B.10.6.2 Example Work Products:

- new product-line definition.

B.10.6.3 Notes

The objective of this practice is to improve product quality, increase productivity, decrease life-cycle cost, and decrease the cycle time for product development.

B.11 PA20 - Manage Systems Engineering Support Environment

B.11.1 Process Area

B.11.1.1 Security Considerations

The development of products in the communications security and trusted software development environments will present unique requirements in BP.20.02, BP.20.03 and BP.20.04, such as assurance needs, cleared personnel and chain of custody.

The Security Engineering Support Environment should be included in the activities of PA03. PA06 should be affirmed through a properly managed Security Engineering Support Environment.

B.11.1.2 Summary Description

The purpose of Manage Systems Engineering Support Environment is to provide the technology environment needed to develop the product and perform the process. Development and process technology is inserted into the environment with a goal of minimizing disruption of development activities while upgrading to make new technology available.

The technology needs of an organization change over time, and the efforts described in this process area must be re-executed as the needs evolve.

B.11.1.3 Goals:

- The systems engineering support environment maximizes process effectiveness.

B.11.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.20.01 Maintain awareness of the technologies that support the organization's goals.

BP.20.02 Determine requirements for the organization's systems engineering support environment based on organizational needs.

BP.20.03 Define, develop or create a systems engineering support environment that meets the requirements established in Determine Support Requirements by using the practices in the Analyse Candidate Solutions process area.

BP.20.04 Tailor the systems engineering support environment to individual project's needs.

BP.20.05 Insert new technologies into the systems engineering support environment based on the organization's business goals and the projects' needs.

BP.20.06 Maintain the systems engineering support environment to continuously support the projects dependent on it.

BP.20.07 Monitor the systems engineering support environment for improvement opportunities.

B.11.1.5 Process Area Notes

This process area addresses issues pertaining to the systems engineering support environment at both a project level and at an organizational level. The elements of a support environment consist of all the surroundings of the systems engineering activities, including:

- computing resources;
- communications channels;
- analysis methods;
- the organization's structures, policies and procedures;
- machine shops;
- chemical process facilities;
- environment stress facilities;
- systems engineering simulation tools;
- software productivity tools;
- proprietary systems engineering tools; and
- work space.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA20 are addressed in the remaining activities of the Environment Management Process of ISO/IEC 15288.

B.11.2 BP.20.01 - Maintain Technical Awareness

Maintain awareness of the technologies that support the organization's goals.

B.11.2.1 Description

Awareness of the current state of the art or state of the practice is a necessary element for assessing improvement options. Therefore, to insert new technology, a sufficient awareness of new technology must be present in the organization. Such awareness may be maintained internally or acquired.

B.11.2.2 Example Work Products:

- reviews of support environment technology.

B.11.2.3 Notes

Maintaining awareness may be accomplished by reading industry journals, participating in professional societies, and establishing and maintaining a technical library.

B.11.3 BP.20.02 - Determine Support Requirements

Determine requirements for the organization's systems engineering support environment based on organizational needs.

B.11.3.1 Description

An organization's needs are primarily determined by assessing competitiveness issues. For example, does the organization's support environment hinder the organization's competitive position? Does each major element of the organization's support environment allow systems engineering to operate with sufficient speed and accuracy?.

B.11.3.2 Example Work Products:

- requirements for systems engineering support environment.

B.11.3.3 Notes

Determine the organization's needs for computer network performance, improved analysis methods, computer software, and process restructuring.

B.11.4 BP.20.03 - Obtain Systems Engineering Support Environment

Define, develop or create a systems engineering support environment that meets the requirements established in Determine Support Requirements by using the practices in the Analyse Candidate Solutions process area.

B.11.4.1 Description

Determine the evaluation criteria and potential candidate solutions for the needed systems engineering support environment. Then, select a solution using the practices in process area PA09. Finally, obtain and implement the chosen systems engineering support environment.

B.11.4.2 Example Work Products:

- systems engineering support environment.

B.11.4.3 Notes

The systems engineering support environment may include many of the following: software productivity tools, tools for simulating systems engineering, proprietary in-house tools, customized commercially available tools, special test equipment, and new facilities.

B.11.5 BP.20.04 - Tailor Systems Engineering Support Environment

Tailor the systems engineering support environment to individual project's needs.

B.11.5.1 Description

The total support environment represents the needs of the organization as a whole. An individual project, however, may have unique needs for selected elements of this environment. In this case, tailoring the elements of the systems engineering support environment elements can allow the project to operate more efficiently.

B.11.5.2 Example Work Products:

- tailored systems engineering support environment.

B.11.5.3 Notes

Tailoring allows an individual project to customize its systems engineering support environment. For example, project A does not involve signal processing, so signal processing automation tools are tailored out of (i.e., not provided to) this project's automation tool set. Conversely, project B is the only project in the organization that has a need for automated requirements tracing, so the appropriate tools are tailored into (i.e., provided in addition to) this project's automated tool set.

B.11.6 BP.20.05 - Insert New Technology

Insert new technologies into the systems engineering support environment based on the organization's business goals and the projects' needs.

B.11.6.1 Description

The organization's systems engineering support environment must be updated with new technologies as they emerge and are found to support the organization's business goals and the projects' needs.

Training in the use of the new technology in the systems engineering support environment must be provided.

B.11.6.2 Example Work Products:

- new systems engineering support environment.

B.11.6.3 Notes

Inserting new technologies into the organization's support environment presents several difficulties. To minimize these difficulties, follow the steps below:

- test the new technology thoroughly;
- decide whether to insert the improvement across the entire organization or in selected portions of the organization;
- provide early notification of the impending change to those who will be affected;
- provide any necessary “how to use” training for the new technology; and
- monitor the acceptance of the new technology.

B.11.7 BP.20.06 - Maintain Environment

Maintain the systems engineering support environment to continuously support the projects dependent on it.

B.11.7.1 Description

Maintain the systems engineering support environment at a level of performance consistent with its expected performance. Maintenance activities could include computer system administration, training, hotline support, availability of experts, evolving/expanding a technical library, etc.

B.11.7.2 Example Work Products:

- performance report for the systems engineering support environment.

B.11.7.3 Notes

Maintenance of the systems engineering support environment could be accomplished several ways, including:

- hire or train computer system administrators;
- develop expert users for selected automation tools;
- develop methodology experts who can be used on a variety of projects; and
- develop process experts who can be used on a variety of projects.

B.11.8 BP.20.07 - Monitor Systems Engineering Support Environment

Monitor the systems engineering support environment for improvement opportunities.

B.11.8.1 Description

Determine the factors that influence the usefulness of the systems engineering support environment, including any newly inserted technology. Monitor the acceptance of the new technology and of the entire systems engineering support environment.

B.11.8.2 Example Work Products:

- reviews of the technology used in the systems engineering support environment.

B.11.8.3 Notes

Design most monitoring to be an automated, background activity, so that users of the support environment do not need to provide data consciously. Also provide a way for users of the systems engineering support environment to consciously provide inputs on the usefulness of the current systems engineering support environment and to suggest improvements.

B.12 PA21 - Provide Ongoing Skills and Knowledge

B.12.1 Process Area

B.12.1.1 Security Considerations

Training needs to be provided in the organization's security engineering process.

B.12.1.2 Summary Description

The purpose of Provide Ongoing Skills and Knowledge is to ensure that projects and the organization have the necessary knowledge and skills to achieve project and organizational objectives. To ensure the effective application of these critical resources that are predominantly available only from people, the knowledge and skills requirements within the organization need to be identified, as well as the specific project's or organization's needs (such as those relating to emergent programs or technology, and new products, processes, and policies).

Needed skills and knowledge can be provided both by training within the organization and by timely acquisition from sources external to the organization. Acquisition from external sources may include customer resources, temporary hires, new hires, consultants, and subcontractors.

B.12.1.3 Goals:

- The organization has the skills necessary to achieve project and organizational objectives.

B.12.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.21.01 Identify needed improvements in skills and knowledge throughout the organization using the projects' needs, organizational strategic plan, and existing employee skills as guidance.

BP.21.02 Evaluate and select the appropriate mode of acquiring knowledge or skills with respect to training or other sources.

BP.21.03 Ensure that appropriate skills and knowledge are available to the systems engineering effort.

BP.21.04 Prepare training materials based upon the identified training needs.

BP.21.05 Train personnel to have the skills and knowledge needed to perform their assigned roles.

BP.21.06 Assess the effectiveness of the training to meet the identified training needs.

BP.21.07 Maintain records of training and experience.

BP.21.08 Maintain training materials in an accessible repository.

B.12.1.5 Process Area Notes

The choice of training source, internal or external, for the needed skills and knowledge is often determined by the availability of training expertise, the project's schedule, and business goals. Successful internal training programs result from an organization's commitment. In addition, they are administered in a manner that optimizes the learning process, and that is repeatable, assessable, and easily changeable to meet new needs of the organization. Training is not limited to “classroom” events: it includes the many vehicles that support the enhancement of skills and the building of knowledge. When internal training is not a viable approach due to schedule or availability of training resources, external sources of the needed skills and knowledge are pursued.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA 21 are addressed in the some of the activities of the Resource Management Process of ISO/IEC 15288.

B.12.2 BP.21.01 - Identify Training Needs

Identify needed improvements in skills and knowledge throughout the organization using the projects' needs, organizational strategic plan, and existing employee skills as guidance.

B.12.2.1 Description

This base practice determines the improvements that are needed in skills and knowledge within the organization. The needs are determined using inputs from existing programs, the organizational strategic plan, and a compilation of existing employee skills. Project inputs help to identify existing deficiencies which may be remedied through training or acquisition of skills and knowledge by other means. The organizational strategic plan is used to help identify emerging technologies, and the existing skills level is used to assess current capability.

Identification of skills and knowledge needs should also determine training that can be consolidated to achieve efficiencies of scale, and increase communication via the use of common tools within the organization. Training should be offered in the organization's systems engineering process and in tailoring the process for specific projects.

B.12.2.2 Example Work Products:

- organization's training needs; and
- project skills or knowledge.

B.12.2.3 Notes

The organization should identify additional training needs as determined from appraisal findings and as identified by the defect prevention process. The organization's training plan should be developed and revised according to a documented procedure. Each project should develop and maintain a training plan that specifies its training needs.

B.12.3 BP.21.02 - Select Mode of Knowledge or Skills Acquisition

Evaluate and select the appropriate mode of acquiring knowledge or skills with respect to training or other sources.

B.12.3.1 Description

The purpose of this practice is to ensure that the most effective method is chosen to make needed skills and knowledge available to projects in a timely manner. Project and organizational needs are analysed, and the methods of PA09 are employed to choose among alternatives such as consultants, subcontractors, knowledge acquisition from identified subject matter experts, or training.

B.12.3.2 Example Work Products:

- survey of needed skills or knowledge; and
- trade-study results indicating the most effective mode of skills or knowledge acquisition.

B.12.3.3 Notes

Example criteria which may be used to determine the most effective mode of acquiring knowledge or skills acquisition include:

- time available to prepare for project execution;
- business objectives
- availability of in-house expertise; and
- availability of training.

B.12.4 BP.21.03 - Assure Availability of Skills and Knowledge

Ensure that appropriate skills and knowledge are available to the systems engineering effort.

B.12.4.1 Description

This practice addresses acquisition of the full range of skills and knowledge which must be made available to the project systems engineering effort. Through deliberate assessment and preparation, plans can be developed and executed to make available the range of required knowledge and skills, including functional engineering skills, application problem-domain knowledge, interpersonal skills, multi disciplinary skills, and process-related skills. After the needed skills have been identified, evaluations of the appropriate mode of knowledge or skills acquisition can be used to select the most effective approach.

B.12.4.2 Example Work Products:

- assessment of skills types needed by skills category;
- project knowledge acquisition plan;
- training plan; and
- list of identified and available subject matter experts.

B.12.4.3 Notes

Appropriate coverage of the full range of skills and knowledge types can be addressed with a checklist of knowledge types (e.g., functional engineering, problem domain, etc.) against each element of the work breakdown structure.

An example of ensuring the availability of the appropriate application problem domain knowledge (e.g., satellite weather data processing), would be a plan to interview identified subject matter experts in connection with requirements interpretation or system design. Such an approach would be appropriate when an organization does not have the required expertise available (as with the first program in a new line of business).

B.12.5 BP.21.04 - Prepare Training Materials

Prepare training materials based upon the identified training needs.

B.12.5.1 Description

Develop the training material for each class that is being developed and facilitated by people within the organization, or obtain the training material for each class that is being procured.

B.12.5.2 Example Work Products:

- course descriptions and requirements;
- training material.

B.12.5.3 Notes

Course description should include:

- intended audience;
- preparation for participation;

- training objective;
- length of training;
- lesson plans; and
- criteria for determining the students' satisfactory completion.

Prepare:

- procedures for periodically evaluating the effectiveness of the training and special considerations, such as piloting and field testing the training course;
- needs for refresher training, and opportunities for follow-up training;
- materials for training a specific practice to be used as part of the process (e.g., method technique);
- materials for training a process;
- materials for training in process skills such as statistical techniques, statistical process control, quality tools and techniques, descriptive process modelling, process definition, and process measurement; and
- review the training material with instructional experts, subject matters experts, and students from the pilot programs, as appropriate.

B.12.6 BP.21.05 - Train Personnel

Train personnel to have the skills and knowledge needed to perform their assigned roles.

B.12.6.1 Description

Personnel are trained in accordance with the training plan and developed material.

B.12.6.2 Example Work Products:

- trained personnel.

B.12.6.3 Notes

Offer the training in a timely manner (just-in-time training) to ensure optimal retention and the highest possible skills level:

- a procedure should exist to determine the skills level of the employee prior to receiving the training to determine if the training is appropriate (i.e., if a training waiver or equivalent should be administered to the employee);
- a process exists to provide incentives and motivate the students to participate in the training; and
- online training/customized instruction modules accommodate different learning styles and cultures, in addition to transferring smaller units of knowledge.

B.12.7 BP.21.06 - Assess Training Effectiveness

Assess the effectiveness of the training to meet the identified training needs.

B.12.7.1 Description

A key aspect of training is determining its effectiveness. Methods of evaluating effectiveness need to be addressed concurrent with the development of the training plan and training material; in some cases, these methods need to be an integral part of the training material. The results of the effectiveness assessment must be reported in a timely manner so that adjustments can be made to the training.

B.12.7.2 Example Work Products:

- analysis of training effectiveness; and
- modification to training.

B.12.7.3 Notes

A procedure should exist to determine the skills level of the employee after receiving the training to determine the success of the training. This could be accomplished via formal testing, on-the-job skills demonstration, or assessment mechanisms embedded in the courseware.

B.12.8 BP.21.07 - Maintain Training Records

Maintain records of training and experience.

B.12.8.1 Description

Records are maintained to track the training that each employee has received and the employee's skills and capabilities.

B.12.8.2 Example Work Products:

- training and experience records.

B.12.8.3 Notes

Records are kept of all students who successfully complete each training course or other approved training activity. Also, records of successfully completed training are made available for consideration in the assignment of the staff and managers.

B.12.9 BP.21.08 - Maintain Training Materials

Maintain training materials in an accessible repository.

B.12.9.1 Description

Courseware material is maintained in a repository for future access by employees and for maintaining traceability in changes in course material.

B.12.9.2 Example Work Products:

- baseline training materials; and
- revisions to training materials.

B.12.9.3 Notes

Maintain a repository of training materials and make it available to all employees (e.g., the organization's library could make books, notebooks, videotapes, etc., available; soft-copy training materials could be maintained in a public file server.) Incorporate lessons learned into training materials and the training program. Update process training materials with all process changes and improvements.

B.13 PA22 - Coordinate with Suppliers

B.13.1 Process Area

B.13.1.1 Security Considerations

The assessed organization acts as the customer when the supplier executes PA10.

B.13.1.2 Summary Description

The purpose of Coordinate with Suppliers is to address the needs of organizations to effectively manage the portions of product work that are conducted by other organizations. Decisions made as a part of this process area should be made in accordance with a defined process. The general term supplier is used to identify an organization that develops, manufactures, tests, supports, etc., a component of the system. Suppliers may take the form of vendors, subcontractors, partners, etc., as the business organization warrants.

In addition to coordination of schedules, processes, and deliveries of work products, affected organizations must have a shared vision of the working relationship. Relationships can range from integrated developer/supplier product teams, to prime contractor/subcontractor, to vendors, and more. A successful relationship between an organization and a supplier depends on the capability of both organizations, and on a mutual understanding of the relationship and expectations.

B.13.1.3 Goals:

- effective suppliers are selected and used.

B.13.1.4 Base Practice List

The following list contains the base practices that are essential elements of good systems engineering:

BP.22.01 Identify needed system components or services that must be provided by other/outside organizations.

BP.22.02 Identify suppliers that have shown expertise in the identified areas.

BP.22.03 Choose suppliers in accordance with a defined process.

BP.22.04 Provide to suppliers the needs, expectations, and measures of effectiveness held by the organization for the system components or services that are to be delivered.

BP.22.05 Maintain timely two-way communication with suppliers.

B.13.1.5 Process Area Notes

When suppliers deliver products that do not meet an organization's needs, the organization has the option to change to another supplier, lower its standards and accept the delivered products, or help the supplier or vendor meet the organization's needs.

The organization acts as the customer when the supplier executes the process area PA10. The organization should help the supplier to achieve full understanding. If the supplier does not have the processes to execute this process area, the organization should coach the supplier in getting the necessary information.

When tracking the performance of this process area, reviewing trends among different Base Practices may indicate if an assurance argument is being satisfied. Refer to PA06.

The topics and content of PA22 is spread over three Processes of ISO/IEC 15288, specifically the Acquisition Process, some of the activities of the Supply Process and some of the activities of the Project Planning Process.

B.13.2 BP.22.01 - Identify Systems Components or Services

Identify needed system components or services that must be provided by other/outside organizations.

B.13.2.1 Description

Rarely does an organization make every component of the system. Make vs. buy analyses and decisions determine which items will be procured. System needs that will be satisfied outside the organization are generally those in which the organization has little expertise or interest.

B.13.2.2 Example Work Products:

- make vs. buy tradeoff study;
- list of system components;
- sub set of system components for outside organizations to address;
- list of potential suppliers; and
- beginnings of criteria for completion of needed work.

B.13.2.3 Notes

Example practices include:

- Perform trade study; and
- Examine own organization to determine missing expertise needed to address system requirements.

B.13.3 BP.22.02 - Identify Competent Suppliers or Vendors

Identify suppliers that have shown expertise in the identified areas.

B.13.3.1 Description

The capabilities of the supplier should be complementary and compatible with those of the organization. Issues that may be of concern include competent development processes, manufacturing processes, responsibilities for verification, on-time delivery, life-cycle support processes, and ability to communicate effectively over long distances (video teleconferencing, electronic file transfers, e-mail and the like).

B.13.3.2 Example Work Products:

- list of suppliers;
- advantages and disadvantages of each supplier; and
- potential ways of working over physical distances with suppliers.

B.13.3.3 Notes

Example practices include:

- Read trade journals;
- Use available library services; and
- Use organizational knowledge-base (perhaps an online system).

B.13.4 BP.22.03 - Choose Supplier or Vendors

Choose suppliers in accordance with a defined process.

B.13.4.1 Description

Suppliers are selected in a logical and equitable manner to meet product objectives. The characteristics of a supplier that would best complement the organization's abilities are determined, and qualified candidates are identified.

B.13.4.2 Example Work Products:

- organization weaknesses which might be mitigated by a supplier;
- characteristics of the desired working relationships with the supplier;
- supplier requirements;
- customer requirements to be provided to supplier;
- selected supplier; and
- captured rationale for selected supplier.

B.13.4.3 Notes

An important consideration in the selection of the supplier is the expected working relationship. This could range from a highly integrated product team to a classical “meet the requirements” relationship. The selection criteria are likely different, depending of the desired relationship.

B.13.5 BP.22.04 - Provide Expectations

Provide to suppliers the needs, expectations, and measures of effectiveness held by the developing organization for the system components or services that are to be delivered.

B.13.5.1 Description

The contracting organization must clearly identify and prioritize its needs and expectations, as well as any limitations on the part of the suppliers. The organization works closely with suppliers to achieve a mutual understanding of product requirements, responsibilities, and processes that will be applied to achieve program objectives.

B.13.5.2 Example Work Products:

- needs statement;
- technical performance parameters; and
- verification specifications.

B.13.5.3 Notes

Examples of techniques and forums for providing needs, expectations, and measures of effectiveness to suppliers or vendors include:

- trade studies;
- formal contracts;
- in-process reviews;
- joint meetings; and
- payment milestones.

B.13.6 BP.22.05 - Maintain Communications

Maintain timely two-way communications with suppliers.

B.13.6.1 Description

The organization and supplier establish a mutual understanding of expected and needed communications.

Characteristics of communications that are established include the types of information that are considered open and subject to no restrictions, the types of information subject to restrictions (e.g., policy or contractual relationships), the expected timeliness of information requests and responses, tools and methods to be used for communications, security, privacy, and distribution expectations. The need for “face-to-face” versus “at-a-distance” communications, and the need and mechanism for archiving communications are also considered.

B.13.6.2 Example Work Products:

- contractually required communication;
- communications tools;
- communications plans; and
- communications distribution lists.

B.13.6.3 Notes

An effective communications environment between the organization and supplier is essential. E-mail and voice-mail tools are effective for simple communications where two-way communication is not required.

Communications that affect schedule cost or scope should be restricted to authorized parties.

Annex C
(informative)

Capability Maturity Model Concepts

C.1 General

The purpose of this clause is to provide an overview of the concepts and constructs used in the SSE-CMM®. It provides information on the requirements that guided the design of the SSE-CMM®, a description of the architecture, and a section on key concepts and terms which are helpful in understanding the model. It serves as an introduction to the detailed discussion of the model in Clause 6.

The SSE-CMM® provides a community-wide (Government and industry) standard metric to establish and advance security engineering as a mature, measurable discipline. The model and its appraisal methods ensure that security is an integral part of engineering efforts that encounter hardware, software, systems, or enterprise security issues. The model defines characteristics of a security engineering process that is explicitly defined, managed, measured, controlled, and effective in all types of engineering efforts.

C.2 Process Improvement

Process is a sequence of steps performed for a given purpose. It is the system of tasks, supporting tools, and people involved in the production and evolution of some end result (e.g., product, system, or service). Realizing that process is one of the determinants of product cost, schedule, and quality (the others being people and technology), various engineering communities have started to focus on ways to improve their processes for producing products and services.

Process capability refers to an organization's potential. It is a range within which an organization is expected to perform. Process performance is the measure of actual results on a particular project that may or may not fall within the range.

“In a manufacturing plant, a manager observes problems with a certain production line. All he knew, though, was that people on the line make a lot of defective items. His first inclination might be to plead with the workers to work harder and faster. But instead, he collected data and plotted the percentage of defective items. The plot showed that the number of defective items and the variation from day to day were predictable.” [DEMING86].

This example illustrates a system that is in statistical process control. That is, a specific range defines the capability, and the limits of variation are predictable. There is a stable system for producing defective items. The example illustrates that having a system in statistical process control does not imply the absence of defective items.

However, it does mean that repeating the work in roughly the same way will produce roughly the same results. An important point is that statistical control of a process needs to be established in order to identify where effective improvements can be made. Many organizations have used CMM®s as a guide to assist them in achieving statistical process control.

Another concept, process maturity, indicates the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. Process maturity implies a potential for growth in capability and indicates both the richness of an organization's process and the consistency with which it is applied throughout the organization.

Deming's work with the Japanese applied the concepts of statistical process control to industry [DEMING82]. In “Characterizing the Software Process: A Maturity Framework,” Watts Humphrey describes a software-process maturity framework that interprets the work of Deming for the software development process [HUMPHREY88]. Humphrey asserted that “while there are important differences, these concepts are just as applicable to software as they are to automobiles, cameras, wristwatches, and steel. A software-development process that is under statistical control will produce the desired results within the anticipated limits of cost, schedule, and quality.” Applying the concepts of statistical process control to software process, Humphrey describes levels of process maturity that guide organizations in improving their process capability in small, incremental steps. The levels he described form the basis of the SEI (Software Engineering Institute) CMM® for Software.

A CMM® is a framework for evolving an engineering organization from an ad hoc, less organized, less effective state to a highly structured and highly effective state. Use of such a model is a means for organizations to bring their practices under statistical process control in order to increase their process capability. As a result of applying the CMM® for Software, many software organizations have shown favourable results with regard to cost, productivity, schedule, and quality [SEI94]. The SSE-CMM® was developed with the anticipation that applying the concepts of statistical process control to security engineering will promote the development of secure systems and trusted products within anticipated limits of cost, schedule, and quality.

C.3 Expected Results

Based on analogies in the software and other communities, some results of process and product improvement can be predicted. These are discussed below.

C.3.1 Improving Predictability

The first improvement expected as an organization matures is predictability. As capability increases, the difference between targeted results and actual results decreases across projects. For instance, Level 1 organizations often miss their originally scheduled delivery dates by a wide margin, whereas organizations at a higher capability level should be able to predict the outcome of cost and schedule aspects of a project with increased accuracy.

C.3.2 Improving Control

The second improvement expected as an organization matures is control. As process capability increases, incremental results can be used to establish revised targets more accurately. Alternative corrective actions can be evaluated based on experience with the process and other projects process results in order to select the best application of control measures. As a result, organizations with a higher capability level will be more effective in controlling performance within an acceptable range.

C.3.3 Improving Process Effectiveness

The third improvement expected as an organization matures is process effectiveness. Targeted results improve as the maturity of the organization increases. As an organization matures, costs decrease, development time becomes shorter, and productivity and quality increase. In a Level 1 organization, development time can be quite long because of the amount of rework that must be performed to correct mistakes. In contrast, organizations at a higher maturity level can obtain shortened overall development times via increased process effectiveness and reduction of costly rework.

C.4 Common Misunderstandings

The following statements represent some of the common objections to the use of CMM®s. This section is intended to clarify these common misunderstandings.

C.4.1 CMM®s define the engineering process

A common misconception is that CMM®s define a specific process. CMM®s provide guidance for organizations to define their processes and then improve the processes over time. The guidance applies regardless of the particular processes that are performed. CMM®s describe WHAT activities must be performed to help define, manage, monitor, and improve the organization's process rather than exactly HOW the specific activities must be performed.

Discipline-specific CMM®s, such as the SSE-CMM®, require that certain fundamental engineering activities must be performed as part of an engineering process for that discipline, but they do not specify exactly how these engineering activities must be performed.

The basic philosophy behind CMM®s is to empower engineering organizations to develop and improve an engineering process that is most effective for them. This is based on the ability to define, document, and manage the engineering process, and standardize the process throughout the entire organization. The philosophy is not focused on any specific development life cycle, organizational structure, or engineering techniques.

C.4.2 CMM®s are handbooks or training guides

CMM®s are intended to guide organizations in improving their capability to perform a particular process (e.g., security engineering). CMM®s are not intended to be handbooks or training guides for helping individuals improve their particular engineering skills. The goal is for an organization to adopt the philosophy described in the CMM® and use the techniques defined in the CMM® as a guide for defining and improving its engineering process.

C.4.3 The SSE-CMM® is a replacement for product evaluation

It is unlikely that organizational ratings against a CMM® would replace a product evaluation or system certification. But, it could certainly focus the analysis being performed by a third party on areas that have been indicated as weak by the CMM® appraisal. Having a process under statistical process control does not mean that there are no defects. Rather, it makes defects more predictable, so some sampling in the form of analysis is still necessary.

Any benefits anticipated from use of the SSE-CMM® are based on interpretations of experiences using the SEI CMM® for Software. To make claims with regard to the SSE-CMM®'s contribution to evaluations and certifications, the security engineering community will need to reach consensus on what maturity means for security engineering. As in the SEI CMM® for Software, the claims will need to be studied as the SSE-CMM® continues to be used within the community.

C.4.4 Too much documentation is required

When reading a CMM®, it is easy to be overwhelmed by the overabundance of implied processes and plans. CMM®s include requirements to document processes and procedures and to ensure they are performed as documented. While a number of processes, plans, and other types of documentation are called for in CMM®s, the number or type of documents to be developed is not indicated. A single security plan might meet the requirements of many process areas. CMM®s merely indicate the types of information that are to be documented.

C.5 Key Concepts

C.5.1 Introduction

Terms and concepts are introduced in this document that have particular meaning within the context of the SSE-CMM®. This section elaborates on concepts that are critical to effective understanding, interpretation, and use of the SSE-CMM®. Some concepts specific to the model, such as “generic practice” and “base practice,” are defined and discussed in the sections of the model description that address them. The concepts to be discussed in this section are:

- organization;
- project;
- system;
- work product;
- customer;
- process;
- process area;
- role independence;
- process capability;
- institutionalization;
- process management; and
- capability maturity model.

C.5.2 Organizations and Projects

Two terms used within the SSE-CMM® to differentiate aspects of organizational structure are organization and project. Other constructs such as teams exist within business entities, but there is no commonly accepted terminology that spans all business contexts. These two terms were chosen because they are commonly used/understood by most of the anticipated audience of the SSE-CMM®.

C.5.2.1 Organization

For the purposes of the SSE-CMM®, an organization is defined as a unit within a company, the whole company or other entity (e.g., government agency or branch of service), responsible for the oversight of multiple projects. All projects within an organization typically share common policies at the top of the reporting structure. An organization may consist of co-located or geographically distributed projects and supporting infrastructures.

The term “organization” is used to connote an infrastructure to support common strategic, business, and process-related functions. The infrastructure exists and must be maintained for the business to be effective in producing, delivering, supporting, and marketing its products.

C.5.2.2 Project

The project is the aggregate of effort and other resources focused on developing and/or maintaining a specific product or providing a service. The product may include hardware, software, and other components. Typically a project has its own funding, cost accounting, and delivery schedule. A project may constitute an organizational entity of its own, or it may be structured as a team, task force, or other entity used by the organization to produce products or provide services.

The process areas in the domain side of the SSE-CMM® have been divided into the three categories of engineering, project, and organization. The categories of organization and project are distinguished based on typical ownership. The SSE-CMM® differentiates between project and organization categories by defining the project as focused on a specific product, whereas the organization encompasses one or more projects.

C.5.3 System

In the SSE-CMM®, system refers to an:

- integrated composite of people, products, services, and processes that provide a capability to satisfy a need or objective [MIL-STD-499B];
- assembly of things or parts forming a complex or unitary whole (i.e., a collection of components organized to accomplish a specific function or set of functions); and
- interacting combination of elements, viewed in relation to function [INCOSE95].

A system may be a product that is hardware only, hardware/software, software only, or a service. The term “system” is used throughout the model to indicate the sum of the products being delivered to the customer(s) or user(s). Denoting a product as a system is an acknowledgment of the need to treat all the elements of the product and their interfaces in a disciplined and systematic way, so as to achieve the overall cost, schedule, and performance (including security) objectives of the business entity developing the product.

C.5.4 Work Product

Work products are all the documents, reports, files, data, etc., generated in the course of performing any process. Rather than list individual work products for each process area, the SSE-CMM® lists “Example Work Products” of a particular base practice, to elaborate further the intended scope of a base practice. These lists are illustrative only and reflect a range of organizational and product contexts. They are not to be construed as “mandatory” work products.

C.5.5 Customer

A customer is the individual(s) or entity for whom a product is developed or service is rendered, and/or the individual or entity that uses the product or service.

In the context of the SSE-CMM®, a customer may be either negotiated or non-negotiated. A negotiated customer is an individual or entity who contracts with another entity to produce a specific product or set of products according to a set of specifications provided by the customer. A non-negotiated, or market-driven, customer is one of many individuals or business entities who have a real or perceived need for a product. A customer surrogate such as marketing or product focus groups may also represent the customer.

In most cases, the SSE-CMM® uses the term customer in the singular, as a grammatical convenience. However, the SSE-CMM® does not intend to preclude the case of multiple customers.

Note that in the context of the SSE-CMM®, the individual or entity using the product or service is also included in the notion of customer. This is relevant in the case of negotiated customers, since the entity to which the product is delivered is not always the entity or individual that will actually use the product or service. The concept and usage of the term customer in the SSE-CMM® is intended to recognize the responsibility of the security engineering function to address the entire concept of customer, which includes the user.

C.5.6 Process

A process is a set of activities performed to achieve a given purpose. Activities may be performed iteratively, sequentially and/or concurrently. Some activities may transform input work products into output work products needed for other activities. The allowable sequence for performing activities is constrained by the availability of input work products and resources, and by management control. A well-defined process includes activities, input and output artifacts of each activity, and mechanisms to control performance of the activities.

Several types of processes are mentioned in the SSE-CMM®, including “defined” and “performed” processes. A defined process is formally described for or by an organization for use by its security engineers. This description may be contained, for example, in a document or a process asset library. The defined process is what the organization's security engineers are supposed to do. The performed process is what the security engineers actually do.

C.5.7 Process Area

A process area (PA) is a defined set of related security engineering process characteristics, which when performed collectively, can achieve a defined purpose.

A process area is composed of base practices, which are mandatory characteristics that must exist within an implemented security engineering process before an organization can claim satisfaction in a given process area. These concepts are developed further in the section defining the model architecture.

C.5.8 Role Independence

The process areas of the SSE-CMM® are groups of practices, when taken together, achieve a common purpose. But, the groupings are not intended to imply that all base practices of a process are necessarily performed by a single individual or role. All base practices are written in verb-object format (i.e., without a specific subject) so as to minimize the perception that a particular base practice “belongs to” a particular role. This is one way in which the syntax of the model supports the use of it across a wide spectrum of organizational contexts.

C.5.9 Process Capability

Process capability is defined as the quantifiable range of expected results that can be achieved by following a process. The SSE-CMM® Appraisal Method (SSAM), is based upon statistical process control concepts which define the use of process capability. The SSAM can be used to determine process capability levels for each process area within a project or organization. The capability side of the SSE-CMM® reflects these concepts and provides guidance in improving the process capability of the security engineering practices that are referenced in the domain side of the SSE-CMM®.

The capability of an organization's process helps to predict the ability of a project to meet goals. Projects in low capability organizations experience wide variations in achieving cost, schedule, functionality, and quality targets.

C.5.10 Institutionalization

Institutionalization is the building of infrastructure and corporate culture that establish methods, practices, and procedures, even after those who originally defined them are gone. The process capability side of the SSE-CMM® supports institutionalization by providing practices and a path toward quantitative management and continuous improvement. In this way the SSE-CMM® asserts that organizations need to explicitly support process definition, management, and improvement. Institutionalization provides a path toward gaining maximum benefit from a process that exhibits sound security engineering characteristics.

C.5.11 Process Management

Process management is the set of activities and infrastructures used to predict, evaluate, and control the performance of a process. Process management implies that a process is defined (since one cannot predict or control something that is undefined). The focus on process management implies that a project or organization takes into account both product- and process-related factors in planning, performance, evaluation, monitoring, and corrective action.

C.5.12 Capability Maturity Model®

A capability maturity model (CMM®) such as the SSE-CMM® describes the stages through which processes progress as they are defined, implemented, and improved. The model provides a guide for selecting process improvement strategies by determining the current capabilities of specific processes and identifying the issues most critical to quality and process improvement within a particular domain. A CMM® may take the form of a reference model to be used as a guide for developing and improving a mature and defined process.

A CMM® may also be used to appraise the existence and institutionalization of a defined process that implements referenced practices. A capability maturity model covers the processes used to perform the tasks of the specified domain, (e.g., security engineering). A CMM® can also cover processes used to ensure effective development and use of human resources, as well as the insertion of appropriate technology into products and tools used to produce them. The latter aspects have not yet been elaborated for security engineering.

Annex D
(informative)

Generic Practices

D.1 General

NOTE This Annex contains the material that was in Annex A of the previous version of this standard. It is retained as an informative Annex for backwards compatibility purposes.

This annex contains the generic practices, (i.e., the practices that apply to all processes). The generic practices are used in a process appraisal to determine the capability of any process. The generic practices are grouped according to common feature and capability level. The generic practices are divided into the following capability levels, each of which has several common features:

- Capability Level 1 - Performed Informally;
- Capability Level 2 - Planned and Tracked;
- Capability Level 3 - Well Defined;
- Capability Level 4 - Quantitatively Controlled;
- Capability Level 5 - Continuously Improving.

The general format of the capability levels is shown in Figure D.1. The summary description contains a brief overview of the capability level. Each level is decomposed into a set of common features that consist of a set of generic practices. Each generic practice is described in detail following the common feature summary.

Capability Level 1 - Capability Level Title
Summary Description - An overview of the capability level
Common Features List - A list showing the number and name of each common feature
Common Feature 1.1 - Common Feature Title
Summary Description - An overview of the capability level
Generic Practices List - A list showing the number and name of each generic practice
GP 1.1.1 - Generic Practice Title
Description - An overview of this generic practice
Notes - Any other notes about this generic practice
Relationships - Any relationships with other parts of the model
GP 1.1.2...

Figure D.1 — Capability Level Format

D.2 Capability Level 1 - Performed Informally

D.2.1 Capability Level Common Features

D.2.1.1 Common Feature Generic Practices

D.2.1.1.1 Summary Description

Base practices of the process area are generally performed. The performance of these base practices may not be rigorously planned and tracked. Performance depends on individual knowledge and effort. Work products of the process area testify to their performance. Individuals within the organization recognize that an action should be performed, and there is general agreement that this action is performed as and when required. There are identifiable work products for the process.

D.2.1.1.2 Common Features List

This capability level comprises the following common features:

- Common Feature 1.1 - Base Practices Are Performed.

D.2.2 Common Feature 1.1 - Base Practices Are Performed

D.2.2.1 Common Feature Generic Practices

D.2.2.1.1 Summary Description

The Generic Practices of this Common Feature simply ensure that the Base Practices of the Process Area are being performed in some manner. However, the consistency or performance and the quality of the work products produced are likely to be highly variable due to the paucity of controls in place.

D.2.2.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 1.1.1 - Perform the Process.

D.2.2.2 GP 1.1.1 - Perform the Process

D.2.2.2.1 Description

Perform a process that implements the base practices of the process area to provide work products and/or services to a customer.

D.2.2.2.2 Notes

This process may be termed the “informal process.” The customer(s) of the process area may be internal or external to the organization.

D.3 Capability Level 2 - Planned and Tracked

D.3.1 Capability Level Common Features

D.3.1.1 Common Feature Generic Practices

D.3.1.1.1 Summary Description

Performance of the base practices in the process area is planned and tracked. Performance according to specified procedures is verified. Work products conform to specified standards and requirements. Measurement is used to track process area performance, thus enabling the organization to manage its activities based on actual performance. The primary distinction from Level 1, Performed Informally, is that the performance of the process is planned and managed.

D.3.1.1.2 Common Features List

This capability level comprises the following common features:

- Common Feature 2.1 - Planning Performance;
- Common Feature 2.2 - Disciplined Performance;
- Common Feature 2.3 - Verifying Performance; and
- Common Feature 2.4 - Tracking Performance.

D.3.2 Common Feature 2.1 - Planning Performance

D.3.2.1 Common Feature Generic Practices

D.3.2.1.1 Summary Description

The Generic Practices of this Common Feature focus on the aspects of planning to perform the Process Area and its associated Base Practices. Thus the documentation of the process, provision of appropriate tools to perform the process, planning of the performance of the process, training in the performance of the process, allocation of resources to the process and the assignment of responsibility for the performance of the process are all addressed. These Generic Practices form an essential foundation for disciplined performance of the process.

D.3.2.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 2.1.1 - Allocate Resources;
- GP 2.1.2 - Assign Responsibilities;
- GP 2.1.3 - Document the Process;
- GP 2.1.4 - Provide Tools;
- GP 2.1.5 - Ensure Training; and
- GP 2.1.6 - Plan the Process.

D.3.2.2 GP 2.1.1 - Allocate Resources

D.3.2.2.1 Description

Allocate adequate resources (including people) for performing the process area.

D.3.2.2.2 Notes

None.

D.3.2.2.3 Relationships

Identification of critical resources is done in process area PA16.

D.3.2.3 GP 2.1.2 - Assign Responsibilities

D.3.2.3.1 Description

Assign responsibilities for developing the work products and/or providing the services of the process area.

D.3.2.3.2 Notes

None.

D.3.2.3.3 Relationships

This practice is particularly related to process area PA16.

D.3.2.4 GP 2.1.3 - Document the Process

D.3.2.4.1 Description

Document the approach to performing the process area in standards and/or procedures.

D.3.2.4.2 Notes

Participation of the people who perform a process (its owners) is essential to creating a usable process description. Processes in an organization or on a project need not correspond one to one with the process areas in this model. Therefore, a process covering a process area may be described in more than one way (e.g., policies, standards, and/or procedures), to cover a process area, and a process description may span more than one process area.

D.3.2.4.3 Relationships

This is the Level 2 process description. The process descriptions evolve with increasing process capability (see GP 3.1.1, GP 3.1.2, GP 5.1.2, GP 5.2.3 for descriptions of this process).

Standards and procedures that describe the process at this level are likely to include measurements, so that the performance can be tracked with measurement (see common feature 2.4).

This practice is related to process areas PA17 and PA18.

D.3.2.5 GP 2.1.4 - Provide Tools

D.3.2.5.1 Description

Provide appropriate tools to support performance of the process area.

D.3.2.5.2 Notes

The tools required will vary dependent upon the process being performed. The individual(s) performing the process likely have a good understanding of the tools required to perform the process.

D.3.2.5.3 Relationships

Tool changes may be part of process improvements (see GP 5.1.2, GP 5.2.3 for practices on process improvements).

Tools are managed in PA20.

D.3.2.6 GP 2.1.5 - Ensure Training

D.3.2.6.1 Description

Ensure that the individuals performing the process area are appropriately trained in how to perform the process.

D.3.2.6.2 Notes

Training, and how it is delivered, will change with process capability due to changes in how the process(es) is performed and managed.

D.3.2.6.3 Relationships

Training and training management is described in PA21.

D.3.2.7 GP 2.1.6 - Plan the Process

D.3.2.7.1 Description

Plan the performance of the process area.

D.3.2.7.2 Notes

Plans for process areas in the engineering and project categories may be in the form of a project plan, whereas plans for the organization category may be at the organizational level.

D.3.2.7.3 Relationships

Project planning is described in process area PA16.

D.3.3 Common Feature 2.2 - Disciplined Performance

D.3.3.1 Common Feature Generic Practices

D.3.3.1.1 Summary Description

The Generic Practices of this Common Feature focus on the amount of control exercised over the process. Thus the use of plans for the performance of the process, performing the process according to standards and procedures, and placing the work products produced by the process under configuration management are all addressed. These Generic Practices form an important foundation for being able to verify the performance of the process.

D.3.3.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 2.2.1 - Use Plans, Standards, and Procedures; and
- GP 2.2.2 - Do Configuration Management.

D.3.3.2 GP 2.2.1 - Use Plans, Standards, and Procedures

D.3.3.2.1 Description

Use documented plans, standards, and/or procedures in implementing the process area.

D.3.3.2.2 Notes

A process performed according to its process descriptions is termed a “described process.” Process measures should be defined in the standards, procedures, and plans.

D.3.3.2.3 Relationships

The standards and procedures used were documented in GP 2.1.3, and the plans used were documented in GP 2.1.6. This practice is an evolution of GP 1.1.1 and evolves to 3.2.1.

D.3.3.3 GP 2.2.2 - Do Configuration Management

D.3.3.3.1 Description

Place work products of the process area under version control or configuration management, as appropriate.

D.3.3.3.2 Notes

None.

D.3.3.3.3 Relationships

The typical practices needed to support systems engineering in the configuration management discipline are described in process area PA13.

Where process area PA13 focuses on the general practices of configuration management, this generic practice is focused on the deployment of these practices in relation to the work products of the individual process area under investigation.

D.3.4 Common Feature 2.3 - Verifying Performance

D.3.4.1 Common Feature Generic Practices

D.3.4.1.1 Summary Description

The Generic Practices of this Common Feature focus on confirming that the process has been performed as intended. Thus verification that the process was performed in compliance with the applicable standards and procedures, and the auditing of the work products are addressed. These Generic Practices form an important foundation for the ability to track the performance of the process.

D.3.4.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 2.3.1 - Verify Process Compliance; and
- GP 2.3.2 - Audit Work Products.

D.3.4.2 GP 2.3.1 - Verify Process Compliance

D.3.4.2.1 Description

Verify compliance of the process with applicable standards and/or procedures.

D.3.4.2.2 Notes

None.

D.3.4.2.3 Relationships

The applicable standards and procedures were documented in GP 2.1.3 and used in GP 2.2.1.

The quality management and/or assurance process is described in PA12.

D.3.4.3 GP 2.3.2 - Audit Work Products

D.3.4.3.1 Description

Verify compliance of work products with the applicable standards and/or requirements.

D.3.4.3.2 Notes

None.

D.3.4.3.3 Relationships

The applicable standards and procedures were documented in GP 2.1.3 and used in GP 2.2.1.

Product requirements are developed and managed in process area PA10. Verification and validation is further addressed in PA11.

D.3.5 Common Feature 2.4 - Tracking Performance

D.3.5.1 Common Feature Generic Practices

D.3.5.1.1 Summary Description

The Generic Practices of this Common Feature focus on the ability to control the progress of project performance. Thus tracking the performance of the process against a measurable plan, and taking corrective action when the performance of the process deviates significantly from that plan are addressed. These Generic Practices form an essential foundation to having the ability to achieve well-defined processes.

D.3.5.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 2.4.1 - Track with Measurement; and
- GP 2.4.2 - Take Corrective Action.

D.3.5.2 GP 2.4.1 - Track with Measurement

D.3.5.2.1 Description

Track the status of the process area against the plan using measurement in the areas of schedule, cost, and project-related performance.

D.3.5.2.2 Notes

Building a history of measures is a foundation for managing by data, and is begun here. Tracking with measurement provides the foundation for creating well defined data to be used within well defined processes at Capability Level 3. Overall projects can use process improvement measures and information security measures. Data required for calculating measures must be reliable, and the process that is under consideration needs to be measurable. Only processes that can be consistent and repeatable should be considered for measurement.

D.3.5.2.3 Relationships

The use of measurement implies that the measures have been defined and selected in GP 2.1.3 and GP 2.1.6, and data have been collected in GP 2.2.1.

Information security measures are described in process area PA06.

Project tracking is described in process area PA15.

D.3.5.3 GP 2.4.2 - Take Corrective Action

D.3.5.3.1 Description

Take corrective action as appropriate when progress varies significantly from that planned.

D.3.5.3.2 Notes

Progress may vary because estimates were inaccurate, performance was affected by external factors, or the requirements on which the plan was based have changed. Corrective action may involve changing the process(es), changing the plan, or both.

D.3.5.3.3 Relationships

The use of measurement implies that the measures have been defined and selected in GP 2.1.3 and GP 2.1.6, and data have been collected in GP 2.2.1.

Project control is described in process area PA15.

D.4 Capability Level 3 - Well Defined

D.4.1 Capability Level Common Features

D.4.1.1 Common Feature Generic Practices

D.4.1.1.1 Summary Description

Base practices are performed according to a well-defined process using approved, tailored versions of standard, documented processes. The primary distinction from Level 2, Planned and Tracked, is that the process is planned and managed using an organization-wide standard process.

D.4.1.1.2 Common Features List

This capability level comprises the following common features:

- Common Feature 3.1 - Defining a Standard Process;
- Common Feature 3.2 - Perform the Defined Process; and
- Common Feature 3.3 - Coordinate Practices.

D.4.2 Common Feature 3.1 - Defining a Standard Process

D.4.2.1 Common Feature Generic Practices

D.4.2.1.1 Summary Description

The Generic Practices of this common feature focus on the institutionalization of a standard process for the organization. The origin or basis of the institutionalized process may be one or more similar processes used successfully on specific projects. An organization standard process is likely to need tailoring to specific situational usage so the development of tailoring needs is also considered. Thus documentation of a standard process for the organization, and tailoring of the standard process to specific uses are addressed. These Generic Processes form an essential foundation to the performance of defined processes.

D.4.2.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 3.1.1 - Standardize the Process; and
- GP 3.1.2 - Tailor the Standard Process.

D.4.2.2 GP 3.1.1 - Standardize the Process

D.4.2.2.1 Description

Document a standard process or family of processes for the organization that describes how to implement the base practices of the process area.

D.4.2.2.2 Notes

The critical distinction between generic practices 2.1.3 and 3.1.1, the Level 2 and Level 3 process descriptions, is the scope of application of the policies, standards, and procedures. In 2.1.3, the standards and procedures may be in use in only a specific instance of the process, (e.g., on a particular project). In 3.1.1, policies, standards, and procedures are being established at an organizational level for common use, and are termed the “standard process definition.”

More than one standard process description may be defined to cover a process area, as the processes in an organization need not correspond one to one with the process areas in this capability maturity model. Also, a defined process may span multiple process areas. The SSE-CMM® does not dictate the organization or structure of process descriptions. Therefore, more than one standard process may be defined to address the differences among application domains, customer constraints, etc. These are termed a “standard process family.”

D.4.2.2.3 Relationships

The Level 2 process description was documented in GP 2.1.3. The Level 3 process description is tailored in GP 3.1.2.

The process for developing a process description is described in process area PA17.

D.4.2.3 GP 3.1.2 - Tailor the Standard Process

D.4.2.3.1 Description

Tailor the organization's standard process family to create a defined process that addresses the particular needs of a specific use.

D.4.2.3.2 Notes

Tailoring the organization's standard process creates the “level 3” process definition. For defined processes at the project level, the tailoring addresses the particular needs of the project.

D.4.2.3.3 Relationships

The organization's standard process (family) is documented in GP 3.1.1. The tailored process definition is used in GP 3.2.1.

Tailoring guidelines are defined in process area PA17.

D.4.3 Common Feature 3.2 - Perform the Defined Process

D.4.3.1 Common Feature Generic Practices

D.4.3.1.1 Summary Description

The generic practices of this common feature focus on the repeatable performance of a well-defined process. Thus the use of the institutionalized process, the review of the results of the process (i.e., the work products) for defects, and use of data on the performance and results of the process are addressed. These Generic Practices form an important foundation to the coordination of security practices.

D.4.3.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 3.2.1 - Use a Well-Defined Process;
- GP 3.2.2 - Perform Defect Reviews; and
- GP 3.2.3 Use WellDefined Data.

D.4.3.2 GP 3.2.1 - Use a Well-Defined Process

D.4.3.2.1 Description

Use a well-defined process in implementing the process area.

D.4.3.2.2 Notes

A “defined process” will typically be tailored from the organization's standard process definition. A well-defined process is one with policies, standards, inputs, entry criteria, activities, procedures, specified roles, measurements, validation, templates, outputs, and exit criteria that are documented, consistent, and complete.

D.4.3.2.3 Relationships

The organization's standard process definition is described in GP 3.1.1. The defined process is established through tailoring in GP 3.1.2.

D.4.3.3 GP 3.2.2 - Perform Defect Reviews

D.4.3.3.1 Description

Perform defect reviews of appropriate work products of the process area.

D.4.3.3.2 Notes

None.

D.4.3.3.3 Relationships

None.

D.4.3.4 GP 3.2.3 Use WellDefined Data

D.4.3.4.1 Description

Use data on performing the defined process to manage it.

D.4.3.4.2 Notes

Measurement data that were first collected at Level 2 are more actively used at this point, laying the foundation for quantitative management at the next level.

To be useful for tracking performance and managing the process, measures need to provide relevant performance trends over time and point to improvement actions that can be applied to problem areas. Measurements must use well-defined data. Analyzing measures of multiple projects could identify trends and provide organizations with additional information on business impact.

D.4.3.4.3 Relationships

This is an evolution of GP 2.4.2; corrective action taken here is based on a well-defined process, which has objective criteria for determining progress (see GP 3.2.1).

D.4.4 Common Feature 3.3 - Coordinate Practices

D.4.4.1 Common Feature Generic Practices

D.4.4.1.1 Summary Description

The generic practices of this common feature focus on the coordination of activities throughout the project and the organization. Many significant activities are performed by disparate groups within a project and by organization service groups on behalf of the project. A lack of coordination can cause delays or incomparable results. Thus the coordination of intra-group, inter-group, and external activities are addressed. These generic practices form an essential foundation to having the ability to quantitatively control processes.

D.4.4.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 3.3.1 - Perform Intra-Group Coordination;
- GP 3.3.2 - Perform Inter-Group Coordination; and
- GP 3.3.3 Perform External Coordination.

D.4.4.2 GP 3.3.1 - Perform Intra-Group Coordination

D.4.4.2.1 Description

Coordinate communication within an engineering discipline.

D.4.4.2.2 Notes

This type of coordination addresses the need for an engineering discipline to ensure that decisions with regard to technical issues (e.g., Access Controls, Security Testing) are arrived at through consensus. The commitments, expectations, and responsibilities of the appropriate engineers are documented and agreed upon among the those involved. Engineering issues are tracked and resolved.

D.4.4.2.3 Relationships

This generic practice is closely tied to GP 3.2.1 in that processes need to be well defined in order to be effectively coordinated.

Coordination objectives and approaches are addressed in PA07.

D.4.4.3 GP 3.3.2 - Perform Inter-Group Coordination

D.4.4.3.1 Description

Coordinate communication among the various groups within the organization.

D.4.4.3.2 Notes

This type of coordination addresses the need of engineers to ensure that the relationships between technical areas (e.g., Risk Assessment, Design Input, Security Testing) are addressed among affected engineering areas. The intent is to verify that the data gathered as part of GP 3.3.1 is coordinated with the other engineering areas.

A relationship between engineering groups is established via a common understanding of the commitments, expectations, and responsibilities of each engineering activity within an organization. These activities and understandings are documented and agreed upon throughout the organization and address the interaction among various groups within a project/organization. Engineering issues are tracked and resolved among all the affected engineering groups within a project/organization.

D.4.4.3.3 Relationships

This generic practice is closely tied to GP 3.2.1 in that processes need to be well defined in order to be effectively coordinated.

Coordination objectives and approaches are addressed in PA07. Specific security engineering practices for ensuring other engineering groups are provided with timely and accurate input are addressed in PA09.

D.4.4.4 GP 3.3.3 - Perform External Coordination

D.4.4.4.1 Description

Coordinate communication with external groups.

D.4.4.4.2 Notes

This type of coordination addresses the needs of external entities that request or require engineering results (e.g., consumers, certification activities, evaluators).

A relationship between external groups (e.g., customer, systems security certifier, user) is established via a common understanding of the commitments, expectations, and responsibilities of each engineering activity within an organization. The engineering groups will identify, track, and resolve external technical issues.

D.4.4.4.3 Relationships

This generic practice is closely tied to GP 3.2.1 in that processes need to be well defined in order to be effectively coordinated.

Coordination objectives and approaches are addressed in PA07. Security needs of the customer are identified in PA10. The customer's assurance needs are addressed in PA06.

D.5 Capability Level 4 - Quantitatively Controlled

D.5.1 Capability Level Common Features

D.5.1.1 Common Feature Generic Practices

D.5.1.1.1 Summary Description

Detailed measures of performance are collected and analysed. This leads to a quantitative understanding of process capability and an improved ability to predict performance. Performance is objectively managed, and the quality of work products is quantitatively known. The primary distinction from the Well Defined level is that the defined process is quantitatively understood and controlled.

D.5.1.1.2 Common Features List

This capability level comprises the following common features:

- Common Feature 4.1 - Establishing Measurable Quality Goals; and
- Common Feature 4.2 - Objectively Managing Performance.

D.5.2 Common Feature 4.1 - Establishing Measurable Quality Goals

D.5.2.1 Common Feature Generic Practices

D.5.2.1.1 Summary Description

The generic practices of this common feature focus on the establishment of measurable targets for the work products developed by the organization's processes. Thus the establishment of quality goals is addressed. These generic practices form an essential foundation to objectively managing the performance of a process.

D.5.2.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 4.1.1 - Establish Quality Goals.

D.5.2.2 GP 4.1.1 - Establish Quality Goals

D.5.2.2.1 Description

Establish measurable quality goals for the work products of the organization's standard process family.

D.5.2.2.2 Notes

These quality goals can be tied to the strategic quality goals of the organization, the particular needs and priorities of the customer, or to the tactical needs of the project. The measures referred to here go beyond the traditional end-product measures. They are intended to imply sufficient understanding of the processes being used to enable intermediate goals for work product quality to be set and used.

D.5.2.2.3 Relationships

Data gathered via defect reviews (GP 3.2.2) are particularly important in setting goals for work product quality.

D.5.3 Common Feature 4.2 - Objectively Managing Performance

D.5.3.1 Common Feature Generic Practices

D.5.3.1.1 Summary Description

The generic practices of this common feature focus on determining a quantitative measure of process capability and making use of quantitative measures to manage the process. Thus, determining the process capability quantitatively and using the quantitative measures as a basis for corrective action are addressed. These generic practices form an essential foundation to having the ability to achieve continuous improvement.

D.5.3.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 4.2.1 - Determine Process Capability; and
- GP 4.2.2 - Use Process Capability.

D.5.3.2 GP 4.2.1 - Determine Process Capability

D.5.3.2.1 Description

Determine the process capability of the defined process quantitatively.

D.5.3.2.2 Notes

This is a quantitative process capability based on a well-defined (3.1.1 and 3.2.3) and measured process (2.4.1). Measurements are inherent in the process definition and are collected as the process is being performed.

D.5.3.2.3 Relationships

The defined process is established through tailoring in 3.1.2 and performed in 3.2.1.

D.5.3.3 GP 4.2.2 - Use Process Capability

D.5.3.3.1 Description

Take corrective action as appropriate when the process is not performing within its process capability.

D.5.3.3.2 Notes

Special causes of variation, identified based on an understanding of process capability, are used to understand when and what kind of corrective action is appropriate.

D.5.3.3.3 Relationships

This practice is an evolution of GP 3.2.3, with the addition of quantitative process capability to the defined process.

D.6 Capability Level 5 - Continuously Improving

D.6.1 Capability Level Common Features

D.6.1.1 Common Feature Generic Practices

D.6.1.1.1 Summary Description

Quantitative performance goals (targets) for process effectiveness and efficiency are established, based on the business goals of the organization. Continuous process improvement against these goals is enabled by quantitative feedback from performing the defined processes and from piloting innovative ideas and technologies. The primary distinction from the quantitatively controlled level is that the defined process and the standard process undergo continuous refinement and improvement, based on a quantitative understanding of the impact of changes to these processes.

D.6.1.1.2 Common Features List

This capability level comprises the following common features:

- Common Feature 5.1 - Improving Organizational Capability; and
- Common Feature 5.2 - Improving Process Effectiveness.

D.6.2 Common Feature 5.1 - Improving Organizational Capability

D.6.2.1 Common Feature Generic Practices

D.6.2.1.1 Summary Description

The Generic Practices of this common feature focus on comparing the use of the standard process throughout the organization and making comparisons between those different uses. As the process is used opportunities are sought for enhancing the standard process, and defects produced are analysed to identify other potential enhancements to the standard process. Thus goals for process effectiveness are established, improvements to the standard process are identified, and are analysed for potential changes to the standard process. These generic practices form an essential foundation to improving process effectiveness.

D.6.2.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 5.1.1 - Establish Process Effectiveness Goals; and
- GP 5.1.2 Continuously Improve the Standard Process.

D.6.2.2 GP 5.1.1 - Establish Process Effectiveness Goals

D.6.2.2.1 Description

Establish quantitative goals for improving process effectiveness of the standard process family, based on the business goals of the organization and the current process capability.

D.6.2.2.2 Notes

None.

D.6.2.2.3 Relationships

None.

D.6.2.3 GP 5.1.2 - Continuously Improve the Standard Process

D.6.2.3.1 Description

Continuously improve the process by changing the organization's standard process family to increase its effectiveness.

D.6.2.3.2 Notes

The information learned from managing individual projects is communicated back to the organization for analysis and deployment to other applicable areas. Changes to the organization's standard process family may come from innovations in technology or incremental improvements. Innovative improvements will usually be externally driven by new technologies. Incremental improvements will usually be internally driven by improvements made in tailoring for the defined process. Improving the standard process attacks common causes of variation.

D.6.2.3.3 Relationships

Special causes of variation are controlled in 4.2.2.

Organizational process improvement is managed in process area PA18.

D.6.3 Common Feature 5.2 - Improving Process Effectiveness

D.6.3.1 Common Feature Generic Practices

D.6.3.1.1 Summary Description

The generic practices of this common feature focus on making the standard process one that is in a continual state of controlled improvement. Thus eliminating the cause of defects produced by the standard process, and continuously improving the standard process are addressed.

D.6.3.1.2 Generic Practices List

This common feature comprises the following generic practices:

- GP 5.2.1 - Perform Causal Analysis;
- GP 5.2.2 - Eliminate Defect Causes; and
- GP 5.2.3 Continuously Improve the Defined Process.

D.6.3.2 GP 5.2.1 - Perform Causal Analysis

D.6.3.2.1 Description

Perform causal analysis of defects.

D.6.3.2.2 Notes

Those who perform the process are typically participants in this analysis. This is a proactive causal analysis activity as well as reactive. Defects from prior projects with similar attributes can be used to target improvement areas for the new effort.

D.6.3.2.3 Relationships

Results of these analyses are used in GP 5.2.2, and/or GP 5.2.3.

D.6.3.3 GP 5.2.2 - Eliminate Defect Causes

D.6.3.3.1 Description

Eliminate the causes of defects in the defined process selectively.

D.6.3.3.2 Notes

Both common causes and special causes of variation are implied in this generic practice, and each type of defect may result in different action.

D.6.3.3.3 Relationships

Causes were identified in GP 5.2.1.

D.6.3.4 GP 5.2.3 - Continuously Improve the Defined Process

D.6.3.4.1 Description

Continuously improve process performance by changing the defined process to increase its effectiveness.

D.6.3.4.2 Notes

The improvements may be based on incremental improvements (GP 5.1.2) or innovative improvements such as new technologies (perhaps as part of pilot testing). Improvements will typically be driven by the goals established in GP 5.1.1.

D.6.3.4.3 Relationships

GP 5.1.2 may be one source of improvements. Goals were established in GP 5.1.1.

Product technology insertion is managed in PA19.

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- Security Engineering;
- Security Engineering Process Areas;
- Systems/Software Process; and
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